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A NOTABLE CONVENTION

The program of the Newark convention of the American Society of Municipal Improvements, October 9-13, is an evidence of the progressive character of this organization and of the high estimation in which it is held by the engineers who are doing things in the way of municipal improvements. The society has always had the reputation of being hospitable to new ideas and was the first technical or semi-technical organization to which were presented such new ideas as the bitulithic pavement, the wire-cut lug brick, the Imhoff tank, activated sludge and the like. This year most of the modern methods of sewage disposal will be discussed by nearly all those engaged in developing them and the proceedings of the meeting will contain the most complete information obtainable on the subject. The latest on such rapidly developing subjects as street lighting, brick, concrete, wood and granite block paving, garbage and refuse collection and disposal, will also be presented by the experts directly engaged in the work, thus keeping up the society's reputation for being in the forefront of progress.

One of the most important activities of the society is the formulation of standard specifications for the various kinds of pavements and for sewers, sub-committees on specifications for any class of municipal improvements being appointed upon request of the members. The progressive spirit of the organization and its independence of questions of merely business policy are shown by the adoption of standard specifications for the pavements which have demonstrated their value without reference to whether they may be proprietary or not. And at the same time the conservatism of the organization is demonstrated by the fact that it does not adopt standard specifications for any pavement until the pavement has been sufficiently developed to insure good results with such a standard specification.

These standard specifications crystallize the most modern methods of construction, but again the progressive spirit of the organization is shown by the retention of the sub-committees on all the standard forms of construction for the express purpose of reporting each year the valuable new improvements and recommending changes in the specifications, if necessary to admit them.

Our contemporary, *Engineering Record*, does not like the spirit of independence of commercialism which the society exhibits when it passes upon a pavement upon its merits alone, and tries to make the society an object of suspicion, referring to its "going counter to its own rules," leaving the reader to infer that there are rules on this subject which, as a matter of fact, do not exist.

Again, as a matter of fact, the society adds to its "power in the profession" and "its specifications—have a higher standing" because of this very independence of commercialism and this exhibition of "backbone."

There is but this one yelp in public opposition to the policy of the society, which has been developed during its long, useful and really distinguished existence, so that no further attention need be paid to it.

TRAFFIC REGULATION

There are two sources of excess in the operation of vehicles on roads which may need control. One is the speed with which vehicles move and one their weight, the latter being important on the road itself rather for its concentration on the widths of wheels than for the total weight on the vehicle.

In commercial uses these excesses largely regulate themselves. Speed is a question of economy of time as balanced against economy of operation, and, except in serious emergencies, economy of operation is of greater importance than economy of time, so that for commercial uses the vehicle needs little or no regulation as to its speed. Indeed, it is seldom that vehicles in commercial use can develop more speed than that possible on gravel and macadam roads without injuring them. It is only the speed-demon in the pleasure car who needs attention. And he has the sympathy of no one when he violates the stringent regulations which are necessary to curb his propensity to assume control of the whole length as well as breadth of the road.

The motor truck is the weight carrier, and it must carry its weight on broad wheels or they will not stand the punishment, so that this matter, so far as the road is concerned, will regulate itself. The only regulation required seems to be that the tires shall in every case be proportional in width to the load carried, and that the total loads shall not be greater than the bridges of the district can carry.

Further adjustment properly belongs to the road-making authority. If the traffic is of such weight and speed as to demand pavements stronger than macadam or gravel, and the prospective amount is sufficient to warrant providing for it, then the paved road must be built and the bridges must be strengthened.

The only way to determine the necessity for improvement is to permit the traffic to develop, and the only way to develop traffic is to leave it with as little artificial restriction as possible. Traffic regulation should therefore be limited practically to the speed-hog and the designs of wheels on heavy trucks or traction engines which are suitable only for loose earth and not for pavements, and on the less thoroly improved roads to weights that they may not be dangerous to the old bridges.

The motor truck is being developed in a thoroly scientific manner and is growing on economic lines, and its features are, so far, well within the limits of reasonable regulations for road pavements. And there are developments of tire attachments which make the truck available over badly rutted soft roads, if not actual improvers of them.

A BRICK PAVEMENT IN HOLLAND, CENTURIES OLD, STILL SERVICEABLE.

STREET AND ROAD PAVEMENTS

THEIR DESIGN, CONSTRUCTION AND MAINTENANCE

EDITED BY CHARLES CARROLL BROWN, M. AM. SOC. C. E.

THE CONSTRUCTION OF BRICK PAVEMENTS

Written and Compiled by the Editor

This second article of the series and the second on the subject of brick pavements is devoted to the construction of brick pavements. It is assumed that the foundation is completed ready for the placing of the wearing surface and therefore but little attention is paid to it. It is also assumed that the materials to be used have all been approved and that they are ready to haul to the street and place in position.

The handling of the materials is almost wholly a contractor's problem and the article has therefore been written from the contractor's point of view as nearly as possible, presenting methods of securing the best results possible under the standard specifications and reducing to a minimum the necessity of further attention to the pavement after completion of construction and clearing up under the specifications, at least during the guarantee period.

The methods described have been used by contractors noted for good work and are from data gathered from the editor's experience and from contractors, engineers and inspectors familiar with the best construction and expert in securing it.

Invitation is again extended to our readers to add their experience to that here recorded or to discuss any points of difference in theory or practice.

THE standard specifications of the American Society of Municipal Improvements provide that the sand cushion shall be spread to a uniform depth of 1½ inches after rolling.

Thickness of Sand Cushion.

The depth of the sand cushion depends upon the smoothness of the concrete or other base, the uniformity in depth of the bricks and the expertness with which the bricks are rolled. The cushion is intended to remove any such inequalities and should be no thicker than will accomplish this purpose. Specifications have varied from 1 to 3 inches for this thickness, but have settled to the standard given above.

If too great thickness of cushion is used, any displacement of the cushion at any one point will spread and the de-

fective spot will increase in size and rapidly affect a large area of the pavement. The sand must be uniformly dry or it will not compact uniformly under the roller, especially if no rolling is done until the bricks have been laid. The result is an unevenness of the brick surface which cannot be taken out without taking up the brick and re-shaping the sand cushion. If the sand cushion is not rolled before laying the brick, the tendency of the sand to rise between the bricks is greater when the sand is thicker and then the joints cannot be filled full of the joint filler, and disastrous consequences result as detailed below. If the rolling of the bricks is improperly done and they have not been laid closely enough together to make lugs touch blocks and the bricks tend to support each other against overturning under the tractive force of the roller, a certain amount of tipping of the bricks results, which injures the wearing surface, making it ridgy and uneven, besides making it easier for some of the bricks to sink into soft places in the cushion, exaggerating these irregularities of surface.

If the cushion is too thin, there is possibility of solid brick coming into contact with solid concrete over small areas, and then the bricks, if not properly supported by the sand cushion on each side, may break across when a heavy load strikes them right, or may rock, thus breaking the bond of the joints and producing a weak and leaky spot in the surface which will soon develop into a material defect.

Uniformity in the size of brick is now readily attainable within the limits of variation allowable in the standard specifications, ⅛ inch, and it should be economy for the contractor to insist upon the bricks reaching this standard. Under modern methods of laying concrete foundations it is possible at very little increase in cost to product a smooth concrete surface parallel to the finished surface of the street. He can, with care, insure that the bricks shall be rolled properly. When he does all these things, then he should be permitted by the engineer to reduce the thickness of his sand cushion, for the future benefit of the pavement. For a street pavement, the surface of which must reach an exact elevation, this reduction in thickness must be made in the original specifications, thus reducing the cost still further by reducing the depth of excavation by perhaps a half inch. But on a country road where the curbs are set flush with the ground surface, but perhaps slightly below the completed brick surface, the reduction can be made when the contractor has demonstrated his ability to reduce the undesirable inequalities to a minimum.

When the sand-cement cushion is used, the saving in cost of cushion is still greater and well worth the trouble of making the concrete smooth and holding close to the specification for size of brick. If it is properly placed the thickness of the cushion or bed may be reduced to 1 inch and this inch may be counted as 1 inch of the concrete foundation, so that instead of a 6-inch concrete foundation and 1½-inch sand cushion, the base would consist of a 5-inch concrete foundation and 1-inch mortar bed.

Placing the Sand Cushion.

The sand for the cushion may be hauled over the concrete if it has stood long enough to be thoroly set and the wagons or motor trucks are run straight thru, but never without boards laid for the wagons to travel on. Wheelbarrows are better to use for distributing the sand, thus avoiding the heavy wagons on the concrete. The essentials are reasonably clean and dry sand, and if the sand must be dumped anywhere but on the surface of the concrete, platforms must be used so that none of the earth surface will be mixed with it in handling. Carelessness in drying the sand for the cushion and in keeping it dry until it is spread and ready for rolling has been responsible for many rough and irregular brick pavement surfaces. The concrete must of course be swept

The forward end of a brick paving job on Middle Springfield Road, near Paris, Illinois. Note steel side forms thoroly staked in place, gravel used for concrete, concrete in sacks, men filling the loading skip of the concrete mixer, bricks piled along the roadside, and wagon delivery of materials.

clean of any loose stones or other objects of size to interfere with the compacting of the sand.

The sand cushion, according to the standard specifications, must be shaped to a true cross-section of the roadway by means of a template having a steel-faced edge, covering at least half the width of the brick work and so fitted with rollers as to be easily drawn on the curb and guide timbers or rails. If the pavement is less than about 25 feet in width, the template may extend the full width of the street, and if the curbs are set with tops in straight lines, they may serve as the guide timbers. If the street is wider, it will be better to make the template for half of the street, either using two templates or by making one reversible, to use it on either side as desired. Then a timber guide must be used along the center of the street, made of planks the thickness of the sand cushion, 4 inches wide, 16 feet long, dressed on the two sides and laid to a true surface along the center line of the street. If the curb cannot be used for the outer end of the template to run on, guide timbers of the same size must be laid along the curb. A slight excess of sand should be spread so that when the template is drawn there will be 2 or 3 inches of sand pushing along ahead of it. It will be found necessary to put considerable weight on the template to keep it down into position, commonly by men pressing down on it. Care must be taken not to spring the template in this operation, otherwise the sand will be unevenly compressed and uneven in surface. The standard specifications require that half-inch strips be laid on the guide timbers and curbs before drawing the template, thus making the layer of sand a half-inch thicker than the specifications require.

When the sand surface has been properly shaped by the template, the standard specifications require that the cushion shall be slightly moistened and then thoroly rolled over its entire surface with a hand roller of not less than 36 inches diameter, 24 inches in width and weighing not less than 10 pounds per inch of width and having a 12-foot handle. Any irregularities in surface, no matter how slight, must be taken out by the application of additional sand or smoothing off high spots, and the process of smoothing and rolling continued

Laying the brick. Note method of staking the steel channel side forms, green concrete in foreground and the double screed. The first beam levels off the green concrete as it is hauled forward by means of the chain in the foreground. Between the two bars is the dry mixture of sand and cement to form the bearing surface for the bricks. The rear bar is slightly higher than that in front, so as to spread a thin layer of this mortar on the surface. It absorbs water for setting from the green concrete below. The brick laying follows immediately after. Note delivery of bricks by pallets in piles of four; also that the carriers are not always careful to place the bricks in the same position. The inspector in the rear is marking bricks for turning or culling before the roller, still farther in the rear, is run over the surface. The photograph was taken from a point beside the concrete mixer laying the base.

until the sand cushion is all compacted to a uniform solidity. The half-inch strips having been removed from guide timbers and curbs, the template is run over the surface again and the sand smoothed off to its exact surface and elevation. If there is any disturbance of the sand or if new sand must be added to fill depressions, the rolling must be continued until the final test with the template shows the surface to be perfect. It will be found necessary to keep the cushion in preparation at least 50 feet in advance of the brick laying. The sand of this prepared cushion must not be disturbed by stepping on it or dropping bricks or anything else upon it. Any leaves, sticks, small stones or other material of any appreciable size accidentally falling upon it must be removed before the bricks are laid.

The Sand-Cement Cushion.

If the sand-cement cushion is used it must be treated in the same manner as the sand cushion, the only difference being that the sand has thoroly mixed with it, dry, and preferably in a dry concrete or grout mixer, one part of cement to about five parts of sand.

The rolling of the brick can never produce the density of the cushion which the above treatment secures, and certainly cannot approach the uniformity of condition, so that the cushion must not be neglected with the expectation that the rolling of the brick will in any degree take its place. Moreover, if the cushion is not completely compressed, rolling of the brick will force the sand up between the bricks and prevent the filling of the joints with the grout filler as already noted and to be described below.

One of the accompanying photographs shows this tendency even with a well-compacted cushion.

Delivering the Brick.

Ordinarily the bricks for a pavement are delivered along the street after the curbs are set and before the excavation is made for the foundation. They should be so delivered before the foundation is finally prepared for the laying of the brick, whatever the nature of the foundation may be. Much time and money are wasted and lost by contractors in the handling of the brick up to the time of placing in position on the street surface, a large part of which can be saved by taking proper care. Some of these instructions may seem to be too detailed or even useless, but they are all based on actual experiences and close estimates of cost of remedying defects and of extra work caused by wrong handling of materials.

Bricks loaded into cars directly from the kilns are sometimes not completely annealed and are more brittle than they are later. But in any event, they should not be thrown from car to wagon, but should be handled with tongs and clamps or gravity carrier. Careless handling results in chipped corners and edges and broken bricks, which, with any reasonable rigidity of inspection results in rejections. These rejections react upon the price of brick and the contractor loses not only the time expended in handling these uselessly defective brick, but also by paying a higher price for the brick that can remain in place. And the handling includes the unloading from cars, piling along the street, putting in place on the street, culling when laying, turning after laying, rejections again after turning, and removing the rejected brick, with the attendant handling, no small amount of time, when all added together, all of which costs money.

The motor truck or trailer with dumping body is becom-

ing the most satisfactory vehicle for delivering brick, and can dump a load with practically no damage to any of the bricks in it.

In piling, the same care as in loading should be used. And attention to the condition of the bricks in the piles will be worth the trouble of instructing the regular watchmen to look after them. Many bricks are chipped and broken while waiting for the completion of the foundation by boys and men handling them, tipping of piles which are not well made and are not re-piled, knocking by wagons and machinery when piles are not properly located; and on the latter account they sometimes become so dirty from drainage water or spattering of mud that they must be washed before they are used, or the adhesion of the joint filler to the bricks will be prevented and the pavement will always bear the marks of the carelessness in handling, its life being materially shortened on this account.

Laying of Brick.

After the cushion has been properly prepared, the bricks are laid in place. It has now been demonstrated that the most economical method of laying brick on the street, as well as that producing the best results in the completed pavement, is to place the bricks as nearly as possible in the place they will occupy in the completed pavement. This means first, that the courses of brick shall be laid straight, second, the lugs shall all be on the same side, preferably the rear, as the bricks are laid, so that, third, they can be surely set up in close contact with the brick in the preceding course, and fourth, that the brick shall be laid with the best side on top. It will not then be necessary to drive the courses together after the bricks are placed, in an attempt to correct carelessness in laying, with its displacement of the surface of the sand cushion and tendency to tip the bricks so that they will not have a full bearing. Should it be necessary to drive the courses it should be done by a sledge tapped lightly on a 4 by 4-inch timber, 3 feet long, held against the brick.

Brick surface before grout filler is applied. Note the hand roller used for rolling the brick surface; also the concrete mixer. Shoulders will be laid and compacted against the brick edges when the pavement is completed and the steel side forms are removed.

Spreading the first coat of the grout filler for joints. Note the brooms for sweeping the grout into the joints. The concrete mixer and brick-laying gang in the background show how closely the finishing follows the beginning of the pavement laying.

To produce these results easily and economically, it will be necessary to handle the bricks from pile to brick-layer with pallets or by gravity carrier. The brick-layer cannot stop to inspect every brick to see which side should go up, but the man filling the pallets is able to do so with little, if any, loss of time, especially if he is required to place the bricks in his pallet so that when dumped beside the brick-layer they will have the lugs all the same way. He should have intelligence enough to receive instructions as to which is the best side of the brick, and even as to what bricks would probably not be accepted by the inspector and so, when he dumps his pallet of bricks they should be in exactly the position to require the least handling by the brick-layer. If the bricks are handled by gravity carrier, the men or boys placing bricks on the carrier can do some of this work, but those taking the bricks off the carrier for the various brick layers will have most of the placing and selection to do. A little care in selection of those handling the brick and time spent in their instruction will save much time spent later in turning bricks marked by the inspector and again taking them out and replacing with others if they are marked a second time. If 50 per cent. of the brick are set wrong side up the first setting, without the special attention above provided for, it certainly would pay to give the special attention, even if it took time or required a few cents higher wages to those handling the brick. But really it requires only a little special care and attention on the part of the superintendent in selection of workers and supervision of them, with no extra expense. Fifty per cent. of bricks turned is exceptional, but 20 or 25 per cent. is frequently found with careless contractors or superintendents on the job.

The standard specifications provide that when there are more than 10 per cent. of culls in any section, that section shall be taken up and the cushion readjusted.

One small point which adds greatly to the appearance of a pavement and also to its water-shedding quality, is the cutting of the bats required in alternate courses at the sides of the pavement as smoothly as possible and to set the natural face next the curb or expansion joint so that the rougher end will be covered by the joint filler. The job looks better and the joint is more stable and better filled.

The wheelbarrow should never be used in delivering bricks

Applying the second coat of cement filler, which leaves the surface smooth and the joints full. Note the squeegees used in spreading this coat.

to the brick-layers, even if run on boards. The wheel displaces too many bricks, pries open too many joints and produces too much unequal compacting of cushion, both in its travel and where the bricks are dumped.

Rolling the Brick Surface.

To bring the bricks down to perfect bearing and smooth out unevenness due to irregular sizes of bricks or carelessness in placing, the brick surface must be rolled with a light tandem roller, weighing from 3 to 5 tons. If the bricks are set closely, so that the lugs of one brick bear on the surface of the next, and the roller is run slowly, the rolling can be done without displacing the bricks and moving the sand of the cushion but slightly. The roller should be run first lengthwise of the pavement, beginning at the gutter and rolling to the center, and then from the other gutter to the center, unless the crown is at one side. Then the roller should be run diagonally in each direction across the pavement until the surface is smooth and all bricks are in full bearing.

A heavy roller will cause the bricks to tilt and then the uptilted edge may spall under the roller or will project above the filler to be unfairly attacked by the traffic. The horse-drawn roller is also objectionable, mainly from the displacing action on the bricks of the horses' shoes.

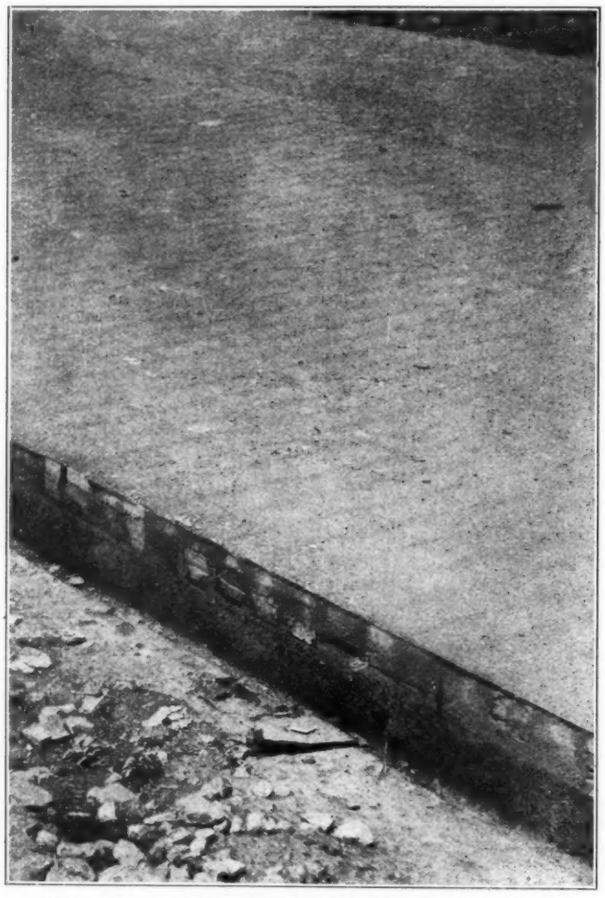
An unevenness in the surface of the pavement on a Florida road, shown in one of the photographs accompanying, which is in process of rolling, may be due to the fact that the rolling has not been done strictly according to specifications, beginning at each curb and working toward the center. It may also be due in part to insufficient compacting of the base, which in this case is the natural sand, compacted by moistening and rolling with an Austin motor roller.

Any areas not reachable by the roller should be tamped with a hand tamper applied on a 2-inch plank.

Expansion Joints.

The placing of the expansion joints along the curbs is a detail which deserves much care, more than it sometimes receives. If the pre-molded expansion strips now on the market are used, such as Genasco asphalt filler, Carey's Elastite, Hydrex and the Pioneer Asphalt Company's Pioneer, there is but little difficulty in placing them, as they may be put in place of the proper width in sufficient number to produce the required thickness of joint. The standard specifications prescribe at least ¾ inch thickness for a street less than 30 feet wide, up to 1½ inches for one 50 feet wide. The brick are laid against them, and the rolling and joint filling can proceed without interruption.

If one of the bituminous joint fillers is used, the space prescribed for the joint must first be filled by two wedge-shaped strips of wood 6 inches wide and dressed on two sides. The strip next the curb is 1 inch wide on top and ½ inch at bottom and the strip next the brick is the same except that its ½-inch edge is at the top. The bricks are laid lightly against the planks to keep them in place, but not so tightly as to bind them in place when they swell from the absorption of water in the grout filler. It is a good plan to loosen up the board next the curb as soon as the filling is completed. When the filler has set the strips are removed and the joint spaces are thoroly cleaned out, so that there will be no solid material to interfere with the expansion of the pavement, and the bituminous filler is poured in until the joint is full. Too much care cannot be taken in cleaning out the joint. Occasionally the reason for a break in a pavement has been mysterious until the presence was discovered of something solid and hard in the expansion joint, which produced an excessive local strain, causing the pavement to give way in joint or brick or by lifting of crown. The practice of filling the space for the expansion joint with sand or like material is very objectionable, as the sand will get into the transverse joints of the paving and interfere with the proper grouting of the pavement, and at the same time it will run out of the



The edge of the monolithic brick pavement, showing concrete base and intimate connection of base and brick layers. A gravel and earth shoulder will be compacted against this vertical surface, which requires no curb.

expansion joint space and thus permit the grout to run into it, where it will give much trouble if not removed and it will be difficult to remove. The sand is hard enough to remove without this added difficulty. Indeed, it is seldom properly removed and a joint thus treated never does its work just right.

Filling the Joints.

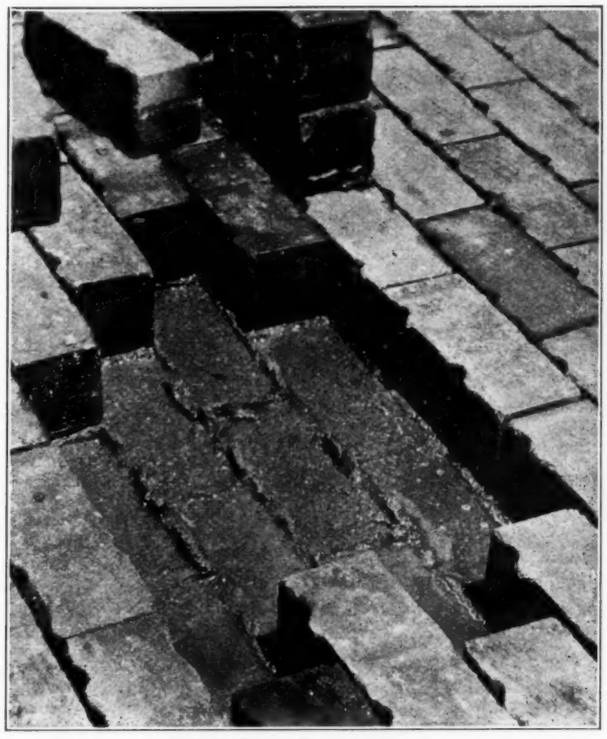
When cement grout filler is used two things are essential to good work, that the grout be kept constantly in motion until put in place, so that the cement and sand will be in contact and everywhere in the same proportions in the joints, thus making the joint filler, when set, of the same hardness and strength thruout, and the same adhesion to the brick. If either of these points is neglected, there may be trouble when expansion of the pavement takes place with rise in temperature or contraction takes place from a fall thereof. If the pavement has been laid as a plane surface, whether level or slightly sloping, with curbs at the sides, the expansion and contraction do not produce actual movement in the pavement, either lengthwise or crosswise, but the tendency to movement is taken up by strains in the brick and in the joints. There should be no bad effects upon such a pavement from changes in the temperature. But if the joints were full of sand at the bottom, as they sometimes are for one-third or more of their depth, and only the upper part of the joint is filled, and this possibly with grout that has been allowed to separate so that the filler is not all of equal strength, then all the force of the expansion must be carried by the small areas of good material. While the whole area of the joint would be able to carry this force, the small area is not. As a consequence, the cement grout filler is crushed and pinched out of the joint or the edge or top surface of the brick is spalled off, according to which is the less able to bear the strain. A break in the surface takes place and the pavement immediately begins to go to pieces. An exaggerated case of this sort, in which almost the whole pavement was involved, came under the eye of the writer a few years ago and led to the general adoption of a specification for rolling the sand cushion. Heavy rolling of the brick had caused the rather loose sand to flow up into the joints and nearly fill them for one-fourth to one-third their depth.

A half-inch of sand is spread on top of the pavement and left until the filler has thoroly set. It should be sprinkled in hot weather.

The standard mixing box of the specifications has been described so often in MUNICIPAL ENGINEERING and is now so generally included in the specifications for brick paving that it need not be described again. Its use is imperative, strictly according to the specifications, unless one of the successful modern grout mixers, such as that of the Harold L. Bond Co., or the Foote Mfg. Co., is used, in which case the best of results are easy to secure.

The pavement should be cleaned and thoroly sprinkled before and kept moist by slight sprinkling during the process of applying the grout. The first application should be swept into the joints as it is spread on the pavement by shoveling from the boxes or discharge from the grout mixers, using coarse rattan or fiber push brooms. When this first grout has settled, but before it has set, the second application should be made and the surface squeegeed with a piece of 4-ply rubber belting, or even a piece of rubber hose about 20 inches long, mounted between two boards with a handle attached. This second coat is applied by the same gang working back over the area covered with the first coat until the joints are certainly even full.

An inch of sand or fine earth should be spread over the finished pavement to remain until the whole pavement has fully set and hardened. In hot, dry weather this layer should be sprinkled at intervals to keep it from abstracting water from the cement. This layer should remain for at least 10 days and more if the weather is cold or otherwise unfavorable to the setting of the cement.



Bricks removed from rolled surface of pavement before the grout filler was applied, showing the nature of the connection between the concrete base and brick layer before the grout is applied to increase the bond between them.

Bituminous fillers for brick pavements may be of tar, or of asphalt. The standard specifications separate them strictly into the two classes, not permitting mixture of tar and asphalt fillers. The melting point of tar is required to be within 5 deg. of 135 deg. F., and it must be heated to a temperature between 300 and 350 deg. F. and poured into the joints until they are completely filled. The asphalt filler must contain at least 98 per cent. of bitumen soluble in carbon disulphide, remain pliable at all street temperatures, be proof against action of water and street liquids, and adhere firmly to the brick. Sand must be spread on top of the pavement after filling in sufficient amount to combine with the surface of the filler and whatever may be spread over the top of the bricks. It should be heated in cold weather to have its full effect. It is quite an art to pour the bituminous filler so that it will completely fill the joints and will not be spread over the entire brick surface. The latter is undesirable because it wastes material and, unless care is taken in supplying the sand, is liable to picking up by shoes and tires to the discomfort and disfigurement of persons and surrounding pavements, floors and carpets before it is worn off by the traffic.

For pouring the bituminous filler a cone-shaped can is used, having a cast iron tip with a ¼-inch hole thru which the hot liquid flows as the can is drawn along the joint with the point resting in it. A plug worked from the handle controls the rapidity of flow. A helper filling the can makes it possible to pour continuously unless the weather is so cold that the cooling of the can and the liquid makes it solidify enough to choke the opening. Multiple spouts on a carriage save time in pouring, but waste material.

One development intimately connected with the bituminous filler is the vertical fiber brick pavement, which will be described later in this series of articles. In brief, the wire-cut side of the brick is laid for the wearing surface and the bituminous filler is spread over the brick surface thick enough to form a wearing surface but not too thick to be held in place by the roughness of the brick surface.

Where the surface of a brick pavement varies from a plane surface irregularly, the design and location of expansion joints is a difficult matter and the use of a bituminous filler makes every joint an expansion joint so that little trouble may arise from expansion and the pavement require little maintenance work and expense on this account.

For the following description of the monolithic construction of brick pavements, the latest development in the continuous line of improvement of the product, we are indebted to Maurice B. Greenough, consulting engineer of the National Paving Brick Manufacturers' Association:

Monolithic Construction of Brick Pavement.

The method of constructing brick pavements whereby the brick are placed in green concrete foundation seeks to secure two results: First, a uniformly smooth surface, and second, a firm bond between the brick wearing surface and the concrete foundation.

At the present time, two methods are in vogue:

First, that whereby the surface of the concrete base is struck off and finished by means of a double template, which at once performs the cutting operation and spreads over the concrete a thin film of mixed sand and cement.

Second, the method whereby the green concrete is struck off by a single or double template, and the green mortar, wherein the brick are laid, is brought to the top by means of a slap board similar to that used in the construction of concrete pavements.

Thin Film Method.

The construction of the template used in the thin film method is of considerable importance. The most satisfactory design which has come to our attention is that in which the two cutting edges are formed by a 6-inch I-beam to the front, and a 6-inch I-beam or channel to the rear, rigidly framed 2 feet on centers, so that the two members are parallel and provided with two rollers at either end. The rear member is framed so that its bottom edge is 3/16 inch higher than the bottom edge of the forward member. The space between the two members is kept filled with a dry mixture of sand and cement in the proportions of one part cement to three of sand, which has been prepared in advance in a small batch mixture.

Operating the Template.

Concrete for the base is deposited on the sub-grade between the steel side forms, and roughly struck off with shovels to a

Constructing a brick pavement on a rolled sand bed near Tampa, Florida. Note several departures from proper procedure. The sand bed is rolled by the three-wheeled roller in the far background, which occasionally displaced the curb. The sprinkling is rather heavy and irregular, making the compaction irregular and subject to later irregular settlement. The men are standing upon and disturbing the sand surface, cause for further irregularity in the brick surface. The brick surface has not been cleaned and cleared so that the Austin 5-ton tandem roller can roll the brick properly, starting from the curb and working toward the center, first on one side and then on the other. This accounts in part for the break in the surface between the rolled and unrolled areas seen in the left foreground. Insufficient compacting of the surface of the natural sand base doubtless has its effect also.

Delivering brick to the bricklayers by Mathews gravity carrier. Note ease with which the bricks can be inspected as they are put on the carrier and again as they are taken off, where they should be placed in the piles so that the bricklayer will not need to turn them to put the best side up or the lugs against the face of the preceding course. Here, too, men are disturbing the sand cushion by standing and walking on it, which will cause unevenness in the brick surface.

depth of about an inch greater than the required finished depth. At the same time it is thoroly spaded and joggled in order to compact the concrete and to bring only mortar in contact with the side forms.

The forward movement of the template performs two operations simultaneously: First, striking off the concrete base, and second, spreading over the surface the 3/16-inch film of dry sand and cement.

Upon the surface thus prepared, which should be absolutely smooth, the brick are immediately laid, observing all the precautions for laying the brick that would be observed in any other type of construction.

Grouting of the pavement is delayed until the close of each working period, when the entire force of men engaged, with the exception of a few who may be cleaning up or doing other odd jobs, is set to work for this purpose. The method of grouting which gives the most satisfactory results in other types of construction is likewise best adapted to the monolithic type of construction, namely, the box and scoop shovel method.

Discussion of Method.

One of the most important factors in securing good workmanship in this type of construction is uniformity in mixing the concrete. Unless uniformity is obtained, there may be formed depressions in the concrete base which will be reflected by a roughness in the surface of the finished pavement.

When the concrete is given its initial rough surface ahead of the template, a thoro spading serves to compact it sufficiently, and then is the time when slight irregularities in consistency across the width of the base may be best eliminated.

The film of sand and cement is applied to the top of the concrete in a dry state. Later, when the brick are laid upon it, there is sufficient weight pressing down upon the concrete to further consolidate it and to bring water enough to the surface to insure a thoro amalgamation of the thin film with the mortar in the base, and later to insure its hardening. Using this thin film of sand and cement eliminates absolutely any roughness in the surface of the concrete upon which the brick are laid.

Laboratory tests on beams of this character, conducted at the Case School of Applied Science, have indicated that sufficient bond strength is developed between the brick and the concrete to withstand horizontal shear long after the beam has failed in cross-breaking.

The brick are rolled immediately after they are laid with a hand roller weighing in the neighborhood of 400 pounds, and so smooth is the surface of the brick when laid that this is entirely heavy enough roller to put on the finishing touches.

The use of this light roller has many advantages over heavy rolling. It eliminates the danger of chipping or cracking the brick. It simply sets the brick in position, rather than forcing them in place, and, furthermore, it is a considerably cheaper operation than using a 3 to 5-ton self-propelled tandem roller.

The general details of construction which have been described here comprise the method recommended by the National Paving Brick Manufacturers' Association as being the most satisfactory plan of operation now in use.

The liability of securing a rough surface is minimized, every operation is a positive one, there is no necessity for men to go back over portions of the concrete already surfaced by the template, and when the day's work is over the pavement is completed up to that point.

Slap-Board Method.

A second method of effecting this type of construction is as follows:

The concrete for the base is deposited on the subgrade and roughly struck off by means of shovels. Either a single or double template is then drawn over it, producing the required thickness. Having been struck off, the green mortar is brought to the surface by means of a slap board, operated by one man at either end, producing a tamping effect on the concrete.

The writer has observed this method in operation during the past season, and from the results which he has seen he places less favor upon this method than on the thin-film method, for the following reasons:

First, the use of the slap board disturbs the surface of the concrete to such an extent that it is liable to produce waves or roughness, which are not eliminated in the subsequent rolling of the brick and which eventually means a rough surfaced pavement.

Second, the extreme fluidity of the green mortar, which is flushed to the surface, frequently causes it to run away from the high points of the pavement to the low points, so that as the brick are laid there is a dearth of green mortar at the high places and a surplus at the lower places. This condition is particularly noticeable on curves where the outside edge of the pavement is elevated.

Third, the writer has observed that where this method is followed, frequently too much water has been brought to the surface of the concrete, causing separation between the sand and cement, which eventually prohibits the formation of a perfect bond between the brick and the concrete.

Fourth, by reason of the lack of uniformity in this bedding surface of green mortar, it is difficult to secure a smooth and uniform surface of the brick with a light roller. If the film is thin, the brick bear directly upon the coarse aggregate of

the concrete, whereas if the film be thicker, the rolling produces an unnecessary movement of the brick, sometimes causing the green mortar to be squeezed up in the joints so that it overflows upon the surface of the brick. This material, of course, possesses some bonding qualities, but is an inferior quality to the cement grout which should fill the joints.

Fifth, the use of the slap board does not produce a surface of uniform characteristics, but rather one having a sort of speckled appearance. Frequently it is necessary to take mortar from the concrete on one place where there is an excess and deposit it in another where there is a lack.

This patch-work manner of securing results is far less satisfactory than positive results secured by means of the double template spreading over the surface of concrete a thin film of sand and cement.

This is a period of transition in brick pavement construction. There is a tendency on the part of contractors each to make his own experiments and find a method which in his opinion possesses the individuality of his own effort. However, this association has made a very careful study of this type. We have observed the various methods of construction used; we have seen uniformly satisfactory results obtained by the use of the double template and the thin film. We have seen some satisfactory, but many other indifferent, results obtained by the use of a slap board.

We feel that if engineers and contractors were fully cognizant of the advantages in the use of the double template and the thin mortar film they would use it practically to the exclusion of other methods.

A demonstration at Paris, Ill., on the 6th of October, 1916, illustrated the association's specifications covering this type of construction.

Some Results.

On country road construction, where the edges of the pavement will be met by earth, gravel or macadam shoulders, the monolithic construction is so strong that it is believed concrete or stone curbs will not be necessary. To leave the edges in proper condition it is necessary to use substantial steel forms in which to place the concrete and the brick during construction, which must be thoroly held in place, so that the edge will be straight and vertical and give as little chance as possible for the wheels of traffic to cause any breaks.

W. T. Blackburn, the consulting engineer of the Dunn Wire-Cut Lug Brick Company, seems to be the engineer to whom should be awarded the credit of starting the development of the new method of construction.

The accompanying photographs are a few selections from a wealth of material illustrating the various steps above described and may aid in understanding what cannot be fully explained with words.

CLEVELAND STREET RAILWAY SITUATION

The Journal of The Engineers' Club of St. Louis contains a paper on the Cleveland Street Railway Situation, by F. W. Doolittle, consulting engineer, New York City, in which he takes up the events preceding the adoption of the "Tayler Ordinance," then that ordinance and the defects in its operation, as disclosed at the time of arbitration of 1913. The Tayler ordinance granted a renewal of the street railway franchise of the Cleveland Railway Co., fixing the rate of fare at 3 cents and 1 cent for transfer, but providing for a fluctuating rate of fare dependent on the cost of service. Mr. Doolittle then describes the efforts since arbitration to reduce the cost of operation in order to permit continuation of low fares and the service rendered under the Tayler ordinance, then the actual cost of service under the Tayler ordinance. From the study of costs in Cleveland and the survey of operating and traffic conditions peculiar to Cleveland, the following conclusions may be drawn:

(1) While the regulating ordinance contemplates fixing the rates of fare to conform with costs, the actual costs of service have considerably exceeded those recognized by the ordinance, due to the inadequacy of allowances for operation and maintenance, the failure to provide reserves for injuries and damages and insurance, and the failure to make due provision for depreciation.

(2) The actual value of property used for the transportation business exceeded that recognized by the ordinance, due to the arbitrary reduction of the cost new of physical property to approximately 70 per cent of such value. To reproduce identical facilities for rendering transportation service would require an investment in excess of that assumed in the ordinance.

(3) The rate of return provided in the ordinance, or 6 per cent, is not comparable with the rate of return necessary to attract money into the urban transportation business under conditions where, unlike Cleveland, such return is not guaranteed.

(4) The actual costs of operation per passenger are considerably less than those of urban transportation systems in other American cities, due to the co-operation of the public and the city of Cleveland. The skip-stop, headway as high as five minutes on heavy lines, the use of trailers and short routing, the loading and collection practice, and the regulation of vehicular traffic, are evidences of this co-operation. These innovations have had a substantial effect on costs.

(5) The scheme of ordinance regulation as provided in Cleveland retards the extensions of existing lines and will in time no doubt materially affect the distribution of population.

(6) The service rendered is found to result in a degree of crowding and a proportion of standing passengers which discloses a standard of service below that prescribed as adequate in other American cities.

(7) While the average rate of fare per revenue passenger is now generally 3 cents, with 1 cent for transfers, in conformity with ordinance costs, the increase of actual costs of operation reflected in the deficiencies of operating allowances leads to the conclusion that the car riding public of Cleveland may expect to face the alternative of higher fares or poorer service.

(8) Taking into consideration further the property abandoned, which is only now partially written off, it would appear that the present generation of car riders is receiving transportation costing in excess of fares paid, leaving future generations to pay for equipment worn out from past service. In effect, such a process of paying for the depreciation of the property results in converting physical property values into service rendered, and if continued would affect the security of the property which the ordinance is pledged to safeguard.

THE AUSTIN DAM

WATERPROOFING THE ROCK FOUNDATION

By Frank S. Taylor, Austin, Texas.

The disasters to which the dam across the Colorado River, near Austin, Texas, has been subject and the studies made to determine the reasons for the failures, make most interesting this story of the work done toward preventing the leakage of water thru the seamy limestone strata on which any dam at this location must rest. The descriptions are in detail sufficient to enable the contractor and the engineer to apply the same methods under like circumstances.

The historical portion of the article shows how the difficulties in the way of financing the construction were overcome. Starting as a purely municipal undertaking it was necessary after the great loss incident to the destruction of the first dam to grant a franchise to a company for the construction and operation of the plant under terms which would ultimately return the plant to municipal ownership.

THIS development, completed after nearly three and one-half years of work, presented several new and extraordinary features of design and construction.

The principal original and noteworthy departures from general practice are: The two sections of dam having crests at different elevations; the automatic crest gates; the arrangement of the sluice gates, and the reinforced concrete turbine chambers, all of which will be hereafter described in their proper places.

Historical.

In May, 1893, the first dam across the Colorado river near Austin, Texas, was completed, and the electrical power and pumping plant, which was driven by the water power derived from the impounded waters of the dam, was put into operation.

At that time, the development attracted world-wide attention, due to the fact that it was then the greatest dam in the world, when both height and length were considered, and the lake formed by it was one of the largest artificial bodies of water ever impounded.

The dam had a gravity section made of cyclopean concrete masonry, and overlaid on both the upstream and downstream sides with cut, red granite blocks. Its height was 60 feet above low water and the total length was 1,235 feet, of which, practically, 1,100 feet was spillway, 110 feet bulkhead on the eastern end, and 25 feet bulkhead on the western end.

The whole development was a municipal undertaking, the money being raised on bonds of the city of Austin, of which $1,400,000 were issued.

The entire river bed for many miles up and down stream, and, in fact, practically all the underlying rock of the county, is limestone, varying from the so-called "dobe," which is a disintegrated limestone, up to the hardest variety. The river bed is seamed with fissures, and there are small cavities of frequent recurrence, ranging from a few inches to several feet in the largest dimension, and these cavities are encountered sometimes as far as 20 feet below the surface of the river bed.

Shortly after the work of construction of the first dam was begun, foundation difficulties began to manifest themselves, and these were followed by other difficulties produced by the personnel of the city government. The engineers in charge could not get their instructions followed, their plans executed or specifications fulfilled. They resigned, one after the other, and their places were filled by other engineers, who also, successively, resigned. In spite of these difficulties, some 600 feet of the western end of the dam were placed on good, firm rock. The rest of the work was done more with a view to completing the dam than to finding a foundation to support it. The draft tubes from the old power station were so located that they discharged against the down-stream toe, and the waters from these draft tubes eroded the soft strata underneath the toe, so that the dam did not rest on a supporting foundation from upstream to downstream side, but merely from the upstream side down to the point where erosion had ceased. This condition continued for seven years, when the inevitable end was reached.

On April 7, 1900, under a flood of 133,000 cubic feet per second, which gave a depth of water of nearly 11 feet over the crest, a section about 200 feet long tilted backwards under the stress, slid down stream, righting itself as it moved, and finally came to rest about 100 feet below the axis of the dam. The impounded waters rushing thru the opening thus formed, eroded the remaining portions of the dam, thereby widening the gap until some 450 feet of the total length of the dam was removed. The power house was wrecked, and several people who were in it at the time were drowned.

This failure was another factor which brought the Austin dam again prominently before the engineering profession, and the peculiar conditions of its failure, together with the other features first mentioned, have made it the most widely known of any modern example of dam construction. This catastrophe deterred the municipality from undertaking the reconstruction of the dam, altho for several years it was agitated from time to time by citizens. Engineers were employed to report on the location of the dam, and several different reports appeared, the general opinion being that the character of the river bed, the limestone and arrangement of the strata made it impossible to construct a safe and water-tight dam at the point where the old structure had been built.

About seven years ago, the municipality, at a considerable expense, had a series of rock borings made, some passing thru the crest of those portions of the dam still remaining, the others made in the gap which was caused by the breaking out of that section on defective foundation, with the result that it was found that the underlying rock was good, hard, and compact below a certain depth under the river bed, and the footing of the old dam. This encouraged the citizens and municipality to undertake some means whereby the dam could be rebuilt.

After many proposals from the city to private companies, and from companies to the municipality, a franchise was granted to Wm. D. Johnson, of Hartford, Conn., on September 11, 1911, which provided that the dam and power plant would be constructed by Johnson or his assigns, and on completion, turned over to the city, Johnson to receive $100,000 in cash on completion and acceptance, and $64,800 per annum

HIGHEST FLOOD EVER RECORDED. SHOWS THE AMOUNT OF WATER WHICH MIGHT PASS OVER THE COMPLETED DAMS IF THE FLOOD OCCURRED WHEN THE RESERVOIR WAS FULL. IT IS PASSING THRU A GAP IN THE UNCOMPLETED DAM.

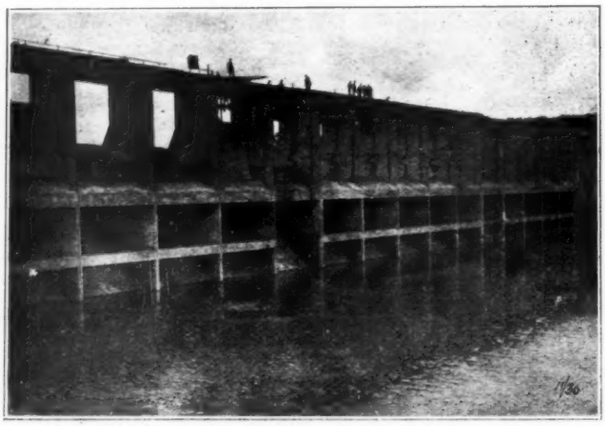
in semi-annual payments for 25 years, making a total payment of $1,720,000, the cash value of which is approximately $1,000,000. In order to carry out the terms of the franchise and to do the construction work, a corporation was formed called the "City Water Power Co., which issued $750,000, face value of 5 per cent., gold, sinking fund bonds, and these bonds were underwritten by Lawrence Barnum & Company, bankers, of New York.

New Plans.

The designs for the new development were begun early in 1910, and work finally began on September 22, 1911. This work was prosecuted on force account from this latter date until June, 1912, when a contract was entered into with the Wm. P. Carmichael Company, of St. Louis, to take over the work and bring it to completion. Work progressed until April, 1913, after which practically nothing was done until January 10, 1914, the entire period between these latter dates being lost by reason of an unprecedented series of heavy floods, culminating in the flood of December 3, which was the highest ever recorded in the history of the river, or memory of any person acquainted with it. It is estimated that the quantity of water passing down the river on that date was between 220,000 and 230,000 cubic feet per second.

After a considerable study of the situation, it was decided that the new development could be made best and most cheaply on the same site as the original dam. While the foundation work for the new dam was more costly than it would have been if the location were changed upstream some 800 or 900 yards, this expense was more than counterbalanced by the ability to use the existing section, which comprised 520 feet length of dam, in good condition and on satisfactory foundation, together with all the bulk-head masonry, which was thoroly good, tho not on proper foundation. Also, the larger portion of the old power house, still standing, could be utilized. The most suitable character of structure with which to fill the gap is a hollow dam, having an inclined deck, thus neutralizing the overturning moment, having buttress walls sunk well into the rock to resist sliding, and with a cut-off wall on the upstream side going down into a trench cut in the rock to such a depth that all waters would be definitely stopped from following any permeable seams.

There was, however, one difficult condition to be met, which was that in order to get the proper amount of power and lake storage, the height of the water level would have to be raised from the old elevation of 60 feet, to 65 feet above low water, which meant that with 11 feet of water over the crest, during times of flood, the maximum water level would be 76 feet above low water instead of 71 feet. That portion of the old section which had given way, failed under a 71-foot elevation of the water level, and it was imperative that that portion of the old section remaining and which would form a part of the new dam, should not be again subjected to as great stresses as it had previously withstood. This required that the maximum water level should never rise even as high as 71 feet above low water. It appeared as if these two conflicting conditions could not be reconciled. However, after considerable study, the arrangement of crest gates, later to be described, was adopted. With this arrangement, the new section of dam was built only 51 feet high from low water to crest, or 9 feet lower than the old section. Piers were built 20 feet apart on both the old and new sections, the upper levels of the piers being the same over the whole length of the structure. Crest gates were placed between the piers, the gates on the old section being 6 feet high, and those on the new section 15 feet high, so that the upper edges of the crest gates are all at the same level, which is 66 feet above low water. When the water level is at an elevation of 65 feet or less, the crest gates are tightly closed. An increase of 6 inches in the elevation of the lake level will make the crst gates automatically overturn, letting the water flow out over the crest of the dam. When the level has fallen 12 to 15 inches, or about down to the 64-foot elevation, the crest gates automatically close. During periods of flood, the crest gates are open, and the greater portion of the flood water is taken over the crest of the new section. It is estimated that with a discharge of 200,000 cubic feet per second, the depth of the water over the crest of the new section will be 18 feet, the depth of the water over the crest of the old section being 9 feet. This means that the present dam will pass 50 per cent. more water than passed over the crest of the old dam when it failed. But the elevation of the water is only 9 feet above the crest of the old dam, while it was 11 feet above the crest



THE UPPER SIDE OF THE COMPLETED DAM. THE FLOOD GATES ARE SHOWN PART RAISED AND PART LOWERED. THEY OPEN AUTOMATICALLY WHEN THE FLOOD REACHES A CERTAIN HEIGHT. THE BRIDGE BETWEEN THE PIERS SUSTAINING THE GATE IS SHOWN ABOVE EXTREME HIGH WATER.

when the weak section went out in 1900. Since the overturning moment varies as the cube of the head of water against the dam, and the sliding force varies as its square, the stresses to which the old section will be subjected can never equal those which it has already resisted. The depth of the water below the low water elevation varies from 5 to 20 feet, so that the total depth of water behind the dam varies from 70 to 85 feet.

Foundation.

As has been pointed out, the river bed and the whole surrounding country are underlaid with limestone, which has many crevices, seams and cavities in it, and these are to be found at varying depths below the surface. About twelve years ago, two United States Government engineers made a short report for the city of Austin, in which they gave an adverse opinion concerning the character of the river bottom for supporting a dam. Of course, at that date, the only type of dam that these engineers considered was the ordinary gravity section. About six years ago the city had a number of borings made by the Sullivan Machinery Company to definitely determine the character of the river bed. The boring chart shows that there were considerable amounts of broken limestone, soft limestone, cavities, seams and fissures encountered, and the records obtained from these borings prove, conclusively, that in order to build a dam across the river at this point, the defects in the strata underlying it would have to be corrected. It was decided to fill all the underlying seams and cavities with grout, and, on the reconstructed river bed, to build a hollow dam of reinforced concrete, of such form that there could be no uplifting force from any leakage of water under it. Furthermore, as a portion of this new section, a cut-off wall would be sunk in a trench cut in the rock on the upstream side and carried to such a depth that its lower edge would be below all permeable strata.

The profiles of the old section, which was carried out in the flood of April, 1900, and of the new section as originally designed, show that the bottom of the new section goes to a depth considerably below the bottom of the old dam.

After the excavations were made it was found necessary in many places to go even deeper than indicated by the borings before a proper quality of rock could be reached. With the type of dam adopted for the new section, it is only necessary that the underlying rock be able to carry the superimposed weight, there being no uplift.

The unit pressure adopted for the wall footings was 166 pounds per square inch, with a few walls where this pressure was carried up to 200 pounds per square inch. Wherever the rock was hard and firm for a depth of 4 feet it was considered satisfactory to resist these bearing pressures. Trenches were cut in the rock to receive the footings, and in the bottoms of these trenches at intervals drill holes were made 4 feet in depth. Wherever these drill holes passed continuously thru solid rock, the trench was accepted as suitable to receive the footing. Wherever the rock was hard, but a cavity was encountered, grout was forced into the cavity and allowed to harden before the footings were built upon it. Wherever soft and defective stone was found below the bottoms of the building trenches, the excavation of these trenches was continued until some point was reached below which the thickness of the good rock was at least 4 feet. This practice applied to the trenches in which the buttress and supporting walls were built. The cut-off wall was carried down in many instances a considerable depth below the footings of the buttresses. This wall, which runs transversely across the river on the upstream side of the dam, was poured in a trench which had previously been tested by numerous drill holes made in the bottom of the trench, and, where defects were found, they were remedied by grouting. These test holes were first made 12 feet apart in the bottom of the trench. Compressed air was turned into them, one by one, to discover whether or not

WATER FLOWING OVER DAM WITH FLOOD GATES CLOSED, BEING THE NORMAL CONDITION. ONE OF THE FLOOD GATES IN THE FOREGROUND IS OPEN TO SHOW THE EFFECT UPON THE FLOW OF WATER. IF ALL WERE OPEN THE RESERVOIR WOULD SOON BE DRAWN DOWN TO THE LEVEL OF THE CREST OF THE DAM.

there was any underground connection between adjacent holes. Wherever the compressed air in entering one hole would blow out of one or more of the other holes, it was considered that all the seams or crevices between the two holes were reached by the drill holes then made. Grout would then be forced into one of the holes until it began to blow out of the others. It was then considered that the rock lying below the cut-off-wall trench and extending between the holes that the grout had entered thru, and those it had begun to blow out of had been made tight and impervious to water. Wherever no connection could be established between the holes 12 feet apart, intermediate holes were drilled, thus making the drill holes only 6 feet apart along certain portions of the cut-off-wall trench. If, after this was done, no connection could be established between adjacent holes, additional holes intermediate to those 6 feet apart were then drilled, bringing the distance apart of the holes to 3 feet.

In nearly every instance where these holes were made water flowed freely thru them, sometimes spouting up 3 or 4 feet, thus proving conclusively connection between the holes made inside the cofferdam and the surrounding body of water. As grout would be forced into the holes the velocity of water flowing out of them would gradually diminish, until it would entirely stop. In many cases, where grout was forced into a hole, the flow of water thru other grout holes, sometimes as far distant as 50 feet, would be stopped, and the grout would finally show, rising out of adjacent holes, proving that the un-

derground seams between these two holes had been thoroly filled with grout.

The grout used consisted of one part portland cement to two parts of sand, mixed with sufficient water to form practically a liquid mixture.

The apparatus used to force the grout into the holes comprises a cylinder of steel plate, 20 inches in diameter by 3 feet long, supported vertically on three legs, the bottom being conically shaped, tapering from the diameter of the cylinder down to a 2-inch discharge opening.

The upper end of the cylinder was provided with an interior cover, held tight by the air pressure from within. Entering the cylinder near its upper end is a connection for a 1-inch air pipe. The grout constituents were poured into the cylinder and compressed air admitted to the lower end of the cylinder, causing the mixture to boil and mix thoroly. This operation usually required about one minute.

After thoroly mixing, the cover was lifted into place and the air pressure turned into the cylinder near the upper end, forcing the grout out of the lower end and into the grout holes. In order to make a proper connection between the discharge end of the pressure grouting cylinder and the holes in the rock, short sections of wrought-iron pipe were sunk into each hole and cement poured around them and allowed to set, so that the upper end of the pipe provided a screw joint by which connection was made between the pressure hose leading from the grouting cylinder to the hole to be grouted. Usually a light air pressure could be applied, under which the grout would flow easily, and, as the hole began to be filled to a greater extent, the air pressure would be increased until when the hole was finally filled the pressure would be raised to 80 pounds per square inch.

By this method, and using great care in locating and filling the holes, a good foundation was secured and thru material of such a character that certain engineers had reported that it would be impossible to construct successfully the dam across the river at this locality.

Subsequent to the completion of the work a cofferdam was built on the down-stream side of the river and pumped out, and all leakage observed. There was practically no leakage thru the foundation or thru the strata below the cut-off wall, and the entire work was shown to be one of the most watertight dams that has ever been constructed.

Reciprocity of Cities Regarding Vehicle Licenses

By Andrew Linn Bostwick, Municipal Reference Librarian, St. Louis Public Library.

Investigation brings out the fact that there is considerable diversity of practice in dealing with the question of the honoring of vehicle licenses in municipalities other than those in which such licenses are issued. The data gathered here relate to fourteen cities, or more correctly, fourteen pair of cities. In six cases the replies received indicate a more or less complete degree of reciprocity. In the remaining three cases, the replies were incomplete; two of these replies, however, were to the effect that certain vehicle licenses were honored. Below will be found a more detailed statement of the practices in the municipalities under consideration.

New York—Jersey City, N. J.

In the case of public hacks a New York license is not honored in any neighboring city. In the case of the states of New York and New Jersey, however, vehicles licensed in one state are privileged to use the streets in the other for a specified time. In the reply from New York City no mention was made of vehicles used for delivery, etc.

Philadelphia—Camden, N. J.

The reply from Philadelphia covered only hucksters' licenses, and is to the effect that there is no reciprocity between Camden and Philadelphia.

Boston—Cambridge, Mass.

There is no law or practice in or about Boston which prevents the free passage of vehicles in and between the several municipalities. In brief, the information is to the effect that Boston and the neighboring cities honor each others' vehicle licenses, provided they do not cover vehicles for hire.

Detroit—Windsor, Ont.

Detroit drivers' licenses are recognized in Windsor, Ontario. The Michigan automobile license, however, is not honored in Canada, altho a bill remedying this condition is now pending in Ontario. No information was received as to the honoring of Windsor licenses in Detroit.

San Francisco—Oakland, Cal.

San Francisco and Oakland do not honor each other's vehicle licenses.

Cincinnati—Covington, Ky.

The reply from Cincinnati is to the effect that every vehicle using the city streets is required to take out a Cincinnati license, and the neighboring cities in Kentucky make the same rule regarding Cincinnati vehicles. Cincinnati derives an annual income from Kentucky vehicles of approximately $5,000.

Newark, N. J.—Jersey City, N. J.

Vehicle licenses issued in Newark are good only in that city. No information was received as to whether Jersey City licenses are good in Newark.

Washington, D. C.—Maryland, Virginia, etc.

The reply from Washington related to motor vehicles only. The District of Columbia honors all foreign automobile licenses and the same courtesy is accorded the District of Columbia licenses by all neighboring states except Maryland.

Minneapolis—St. Paul.

Minneapolis and St. Paul make it a practice to honor each other's vehicle licenses. An ordinance adopted in 1910 specifically states that vehicles duly licensed to do business in another city of the state may carry passengers, baggage and freight from said city where so licensed to any place within the City of Minneapolis without taking out a Minneapolis license.

Kansas City, Mo.—Kansas City, Kan.

Kansas City, Kan., has no vehicle license law, as the statutes of the state do not permit this. The report from Kansas City, Mo., is to the effect that most of the persons from the Kansas side who use vehicles in Kansas City, Mo. in connection with their business are glad to take out licenses for the Missouri side, as they feel that they derive a benefit from the use of the streets. The Kansas City, Mo., legal department has taken the stand that these licenses must be taken out, but as before stated, this has caused little or no resentment on the Kansas side.

Providence—Pawtucket, R. I.

Complete reciprocity exists in this matter between the cities of Providence and Pawtucket.

Omaha—Council Bluffs, Iowa.

Drivers of vehicles from Council Bluffs or other cities around Omaha are not required to take out an Omaha license unless they solicit business on Omaha's streets. A former report on this matter from Omaha gives also the information that the Omaha license is honored in Council Bluffs.

Hartford—East Hartford, Conn.

No reciprocity in licenses exists between Hartford and East Hartford.

The Municipal Supply Department V.

BUDGET — STANDARDIZATION

By Hugh M. Foster, New York City.

This last article of the series rounds it out by connecting the supply department with its superior creators and managers, thus completing the circle which began with the relations of the department with those whom it serves and continued thru the internal management of the department itself.

While the articles are based on experience in New York City, they are applicable to any city supply department and are the more valuable as an exposition of the subject because they cover more ground than would be necessary in any except the very largest cities.

INVESTIGATIONS for supply requirements for provision for annual budget appropriations should be made by the controlling fiscal department in conjunction with the operating departments and not afterward. The practice of sending examiners and investigators to take inventory, check records of quantities and distribution, after this work has all been done within a given department, is a mere duplication and waste of time. If such investigations are undertaken simultaneously and in conjunction with the operating department, time and labor may be saved and friction avoided. The usual bases for estimating budget requirements are, the consumption of last year, plus a reasonable increase for normal increment of consumption and a margin of safety for emergency needs. As far as possible the element of guess work in such investigations and estimates should be eliminated, and anticipation based upon actual past consumption for a given period.

Budget Appropriations.

Budget appropriations for supplies should be based upon actual statistics of all supplies and divided proportionately item for item. While such may be the basis for appropriations, the appropriations themselves can be lumped for supplies for a given department.

After the monetary needs of a department are determined, as far as the tax budget is concerned it is of no importance whether the money is expended for coal or for lamb chops, but the statistics in complete detail by which the totals are arrived at are important.

Emergencies.

The extent to which emergency purchases of supplies are indulged in indicates bad purchasing or bad storekeeping. The reduction of emergency purchases to the minimum indicates the efficiency of the service. In the best regulated system emergencies will occur, but in all cases of actual emergency the head of the department should personally certify, upon information furnished to him, the cause of the emergency and the justification for such purchases.

As illustrations of real emergencies, the Slocum and the Titanic disasters will be recalled. All kinds of food and clothing had to be procured within a few hours' time on those occasions. The purchasing agent of the Department of Health at the time of the Slocum disaster, Saturday afternoon, went out and hired a truck and collected food, clothing and medicines; had them loaded on the truck and had it driven up to North Brothers Island, and reached there in time to render what aid could be given to the victims on that occasion.

Responsibility to Highest Authority.

One of the most important considerations in establishing the Municipal Supply Department is the question of fixing responsibility. A purchasing agent and storekeeper for a city are in a far more vulnerable position than such officials for a private corporation. The mere fact of acting in such a capacity for a government subjects such an official to suspicion and constant criticism. Many acts are excused in private business which would not be tolerated in the public service. For such reasons it is important that both the purchasing agent and the storekeeper should be constantly subjected to the most severe scrutiny.

For this reason alone, if for no other, the power of inspection should be outside the control of both the storekeeper and the general purchasing agent, preferably in the hands of the general auditor of the city or comtroller or chief fiscal officer, as the case may be.

As the purchasing agent has to buy supplies for all operating departments, and the storekeeper has to distribute such supplies to all the departments, both these officials should be independent of all except the highest authority in the city. If the city is a commission-governed one, as is practically the City of New York, with the great powers of the Board of Estimate, the Municipal Supply Department should be directly under the commission or board.

In the government of the City of New York the Mayor is the chief executive and chairman of the Board of Estimate; the Comptroller is the chief fiscal officer and the head of the Department of Finance; the President of the Board of Aldermen is the presiding officer of that board and has three votes in the Board of Estimate and Apportionment. Besides these officials the Board of Estimate and Apportionment includes in its membership the five Boro Presidents.

It has been urged that as the chief executive the Mayor should appoint the general purchasing agent and the general store keeper. This omits any power in such selection by the Comptroller, who is the chief fiscal officer, and omits the President of the Board of Aldermen as the presiding officer of the chief legislative branch of the government. To include both these officials it was proposed to organize a board of purchase, consisting of the Mayor, the Comptroller and the President of the Board of Aldermen. The objection to this plan was that while the five boro presidents are ostensibly the heads of the boro governments and have control of public highways and buildings, buying large quantities and many kinds of supplies for such activities, they have no voice in the management of the department which buys those supplies. The legislature, therefore, made the entire Board of Estimate and Apportionment the head of the supply department as the board of purchase.

This preserves the principle of boro autonomy and precludes the danger of such a department being corrupt or ill-managed by one unworthy official. It is less likely that the whole Board of Estimate would be composed of unfit officials than that any one given office should be occupied by such an undesirable incumbent.

Standardization.

The power of standardization of supplies or the preparation of standard specifications for all supplies by the city should be in the hands of a bureau or commission, independent of the supply department. Its function should be to prepare exact and technical specifications, and while it should act independently, it should be required to prepare specifications only after conferences with all the departments using supplies and with the approval of such departments. Once adopted such specifications should be universally binding until amended.

The general procedure in the preparation of specifications should be the determination of the supplies in use, the requirements therefor, the uniformity of such supplies, the investigation of trade conditions and customs, the reference of results of such investigations to the operating departments, the conformity of departments and specifications by bringing both together to agreement, the selection of the article best suited to the need, and the description of such articles to admit of definiteness of contract and inspection of deliveries.

The basis for standardization is the record of past purchases for the supplies which are to be standardized. In preparing such specifications the encouragement of competition should always be borne in mind. The habit of exhibiting samples with the provision "or equal thereto" should be as far as possible avoided, and in all instances such usages as naming special brands or makes should be discountenanced.

The standard general classification list of the City of New York shows over 23,000 different items of supplies. The magnitude, therefore, of preparing scientific specifications for all these is apparent. The widest publicity should be given to specifications after they are once adopted. They should be distributed to all employees, stewards, storekeepers, purchasing agents, and dealers thruout the trade. Co-operation of other governmental purchasing departments and private corporations should be encouraged.

Another important element in the work of carrying on a proper supply department is adopting standard methods of sampling. It is obvious that an inspection of a barge load of coal, based on a sample which is not truly representative of the whole barge load, is unfair to the dealer and consequently in the long run deleterious to the best interest of the city.

It must also be constantly borne in mind that the best specifications are worthless in the hands of incompetent inspectors, and inferior specifications are proportionately harmful even in the hands of the best inspector, as after all specifications form the basis of inspections, and all work of preparing standard specifications is worse than useless if specifications are not uniformly, universally and rigidly enforced.

Conclusions.

The cry for a business administration of municipal government, which has been raised thruout the country and growing for more than the last decade, is worthless if it is not to be lived up to. In a recent lecture at Columbia University Comptroller Prendergast declared:

"You can get what you want no matter who is in office if you want it hard enough, because, no matter who is in office an administration cannot afford to disregard the wishes of the people if they are made sufficiently aggressive."

It is so proverbial that it is almost a trite truism that no government can rise superior to its citizenship. If you want good government it is up to you.

CHANGES IN CITY BUSINESS DISTRICTS

The change in city land values, thru changes in transportation facilities, is illustrated in the history of the boro of Manhattan, New York. It is but a comparatively few years since the business of the city was done below Fourteenth street, and certain classes of business gradually extended north, as the surface lines of travel and the elevated railways all concentrated in the comparatively small business district on the southern portion of the Island. Brooklyn fed mainly to the southern end of the Island and the railroads from the west, the Grand Central Station at Forty-second street being the terminal farthest north, as it is today. The congestion in the lower part and the land values rose to dizzy heights.

But transportation facilities have changed. Instead of one Brooklyn Bridge there are five, or soon will be. The Pennsylvania Railroad has moved its passenger terminals from Jersey City, opposite the lower Island, to Thirty-eighth street, and has subways to Long Island on the same east and west line. The other tubes across the Hudson River run to this section as well as the southern section, and soon the connection with the eastern railway lines by bridge across Hellgate and the Long Island tunnels will still further emphasize this location.

The result is a movement of the center of things up to a district roughly extending from Thirty-fourth to Fifty-ninth street, and the former southern congested district has experienced an enormous shrinkage in real estate values, except along certain special streets and certain highly specialized districts.

The causes producing this result have been developing slowly and men were slow to recognize the inevitable tendencies, nor have they had breadth of view enough to start the forces to acting which would replace the retiring classes of business with others or with manufacturing industries suitable for such locations.

A movement among the merchants to keep the factories out of the charmed district, which is the center of things, is in process, and would become more promptly successful if it were supplemented by a positive movement to locate such factories in buildings in the deserted districts. Lower rents are now available, and if modern buildings can be offered this movement should be reasonably successful, to the benefit both of the district in which tenants are wanted and of the district in which this particular class of tenants are not wanted.

Rats desert a sinking ship and strong measures will probably be necessary to turn the flow in the directions desired.

The subways seem to the outsider to be the means of salvation for the threatened districts, for they can give transportation facilities from all directions so as to make the whole of Manhattan Island, so far as this one method of transportation is concerned, practically equally accessible from outside. As the subway system is developed and transfers and thru and circular routes are devised, which will sew them all into one continuous fabric, the business and manufacturing population can select their own places of business to avail themselves of the advantages of low rents and good quarters. The subway planner and the modern building constructor can thus work hand in hand to the benefit of every one.

WORKERS IN THE FIELD

Engineering Advice by State Employes

In commenting upon the editorial on Engineering Advice in the July number of MUNICIPAL ENGINEERING, Professor G. R. Bascom, municipal and sanitary engineer in the University Extension Division of the University of Wisconsin, department of correspondence study, says:

So far as our experience has been concerned here at Wisconsin, we have had the kindest co-operation possible from the engineering profession, since the writer has been very determined in limiting out work in such a manner that he not only did not interfere with private practice, but he actually promoted work for the engineers in private practice. This is evidenced by the fact that in each case where we have promoted work to actual construction, there has been, at our suggestion, a private engineer retained to take over the work, draw the detailed plans and specifications, and superintend the construction.

Refuse Disposal by Dumping in Omaha

The Editor of MUNICIPAL ENGINEERING:

Sir:—For many years the City of Omaha has disposed of refuse and rubbish by dumping it on low ground in various parts of the city, the most extensive dumping ground being located at the south end of the west arm of Carter Lake, in the vicinity of 8th and Ohio streets.

In 1913 the City Council proposed to issue bonds for the purpose of constructing an incinerator, but when submitted to a vote of the people the proposition failed to carry.

Last summer the people residing in that portion of the city lying to the northwest of the dump at 8th and Ohio streets protested to the council against further use of that site for dumping purposes on account of the offensive odors arising from the refuse, especially during the summer season.

Mr. W. S. Jardine, Superintendent of the Department of Public Improvements then took the matter in hand and arranged to have the refuse and rubbish loaded into cars, hauled out of the city and dumped where it would not create a nuisance and at the same time could be used to fill up low ground. A site was selected for a dumping ground along what is known as Willow Creek Slough northeast of Carter Lake and about four and one-half miles from the center of the business district, partly on the ground owned by the city and partly on private property. Two parallel tracks were laid along the edge of the slough with the idea of moving them over as the filling of the slough progressed. A steam crane was purchased for the purpose of unloading the cars, and it will also be used to move the track as required.

The loading facilities have not yet been developed on account of the difficulty of securing sites of sufficient size that were accessible to railroad tracks. Sites have now been secured, however, and loading docks will be built so that loaded wagons can be hauled up an incline to a platform directly over the cars, the platform tipped and the load dumped into the cars. At the present cars are being loaded from wagons, by hand, at two stations convenient to the business district.

From 25 cents to 75 cents per load is charged for the privilege of unloading refuse, rubbish, etc., into these cars, the charge being approximately 25 cents per cubic yard. The gross earnings per car average about $12.00 and the city pays a switching charge of $3.00 per car from one station and $2.00 per car from the other.

WATSON TOWNSEND,
Engineer, Dept. of Public Improvements,
Omaha, Neb.

Who Can Help Wake Up this Town?

The Editor of MUNICIPAL ENGINEERING:

Sir—It is with regret that I return unfilled blank which you desired to be filled out giving data of improvements from this town.

I am sorry to say that I am living in a town that has no public spirit to reach out and get the necessities in the way of pavement for streets. We have some sidewalk, but it is built by contractors that are not compelled to build to a fixed grade. It is done this way for we have a bone-head mayor and a bunch of aldermen that have no interest in the future of the town.

I will add, however, that a few years ago we did have a progressive set of aldermen and they started the ball rolling in the right line by beginning at the bottom and having a survey of the entire town made. They located a proper drainage system for the town and followed this up with fixed grades for streets, curb lines and sidewalks. They met so much opposition from the mayor and his bunch that the whole outfit resigned with me thrown in. Since then I have not even opened my mouth, but expect to hunt a live town where things are done right and they do more.

This town has built cement crossings that look and act like full-fledged dams when it rains. For this they paid $10,000.00. On top of this they have recently spent $8,000.00 for fire fixtures when there was no need. If they had taken this $18,000.00 and started paving with it, we would still have the fever and be at it now. With this they have a sewer system that is worthless. They have no maps of the line or a profile for same. They don't know whether the line is above or below grade; as for instance, there was a party that wanted to build a nice home close in. The sewerage was supposed to be 9 feet under ground—it was just 2½ feet. And that is the way all our improvements here are being done.

I have been thinking some time that if I could get in communication with some of the paving people I believe I could work up some interest and get some scheme before these people, for if I can get just one block paved, I would not be afraid but that we could keep the good work going.

W.

FIRE DEPARTMENT

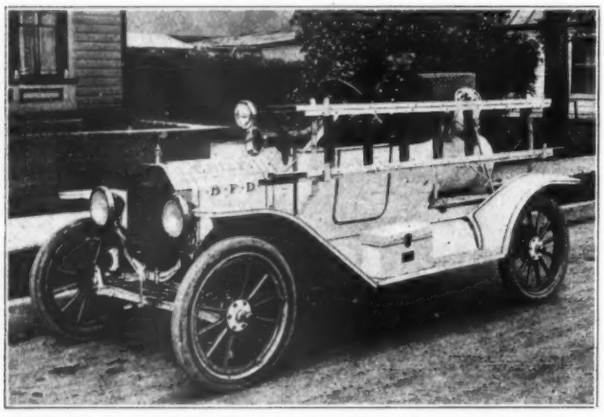
The Ford Metamorphosed

New uses of Ford automobiles are evolving as rapidly as almost-funny Ford stories.

Out in Bozeman, Mont., W. G. Alexander, city fire chief, has taken a standard Ford roadster and, for a total original cost of $900, has developed a car for both inspection and fire-fighting purposes that is satisfactory in every respect.

This outfit works alongside a 90-h.p. combination motor truck and gets to about 80 per cent. of the fires. The cost of upkeep is very small, amounting to only about $3 per month.

The car was purchased from a local garage and the members of the fire department themselves did most of the work of adapting it to the chief's requirements. The tonneau was stripped of the windshield and all unnecessary parts; then was painted white and equipped as follows:

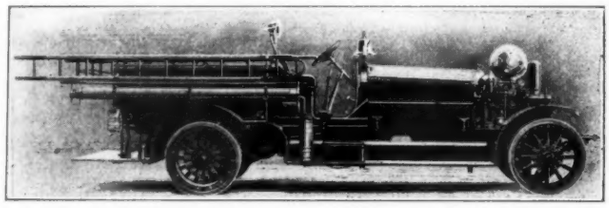


One 30-gallon tank for chemicals taken from an ordinary horse-drawn wagon and attached to the rear of the car; one 3-gallon tank attached to the right-hand running board; one-quart pyrene extinguisher; one chief's portable searchlight; 150 feet of ¾-inch chemical hose in basket; an axe and a crowbar in holders; a dashboard searchlight; one 16-foot extension ladder, fastened on the left side of the tonneau; a drawbar for towing other apparatus if necessary; all electric lights, and an electric siren horn affixed to the dashboard. The total weight is only 2,200 pounds.

Cuban Fire Department Motorizes

It is interesting to note the recent visit to this country of Leopoldo Freyre de Andrade, fire chief of the city of Havana, Cuba. Senor de Andrade made the trip of his own accord and at his own expense in order personally to inspect all different makes and the latest improvements in fire apparatus as shown at the different factories.

His report, after returning to Cuba, advised the purchase of superior apparatus irrespective of its comparative costs with others, and his recommendation resulted in the placement of an extraordinarily large order, amounting to $80,000.

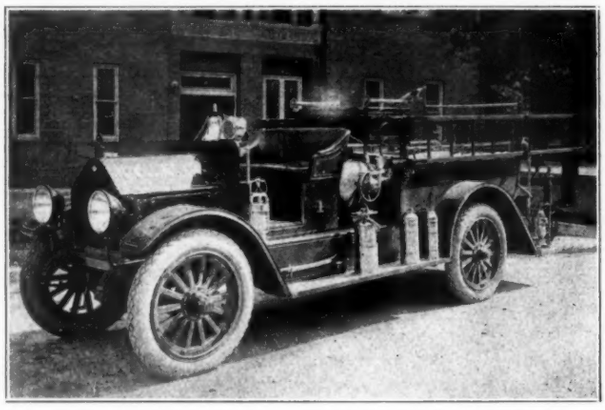


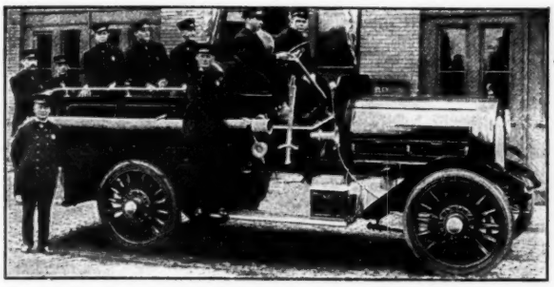
The outfit purchased included one 1,000-gallon auto fire engine (illustrated herewith) and six 700-gallon motor engines, together with two chasses, upon which the Havana fire department will attach ladders. The order also calls for a special squad wagon, all of the machines being made by the Ahrens-Fox Fire Engine Co., of Cincinnati, O.

New Type Engine for Ligonier

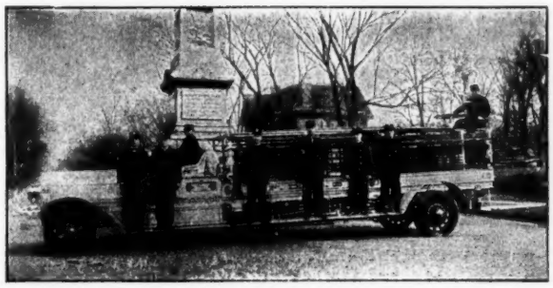
A different type CH-40 combination chemical and hose truck has just been delivered to the city of Ligonier, Ind. The machine is one of the latest models built by the South Bend Motor Car Works, South Bend, Ind., and is equipped with a hose body capable of carrying 1,000 feet of 2½-inch standard rubber-lined fire hose, a 30-gallon chemical tank, 200 feet of chemical hose, one 12-foot roof ladder and one 24-foot extension ladder.

This car is capable of making from 30 to 40 miles per

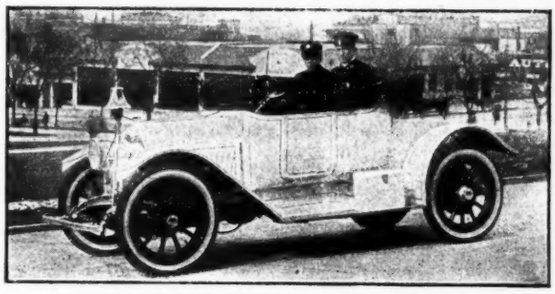




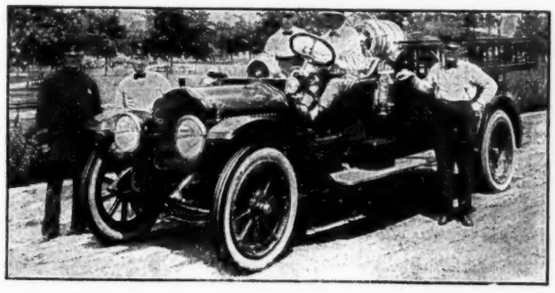
NOTT COMBINATION ENGINE HOSE, CLEVELAND, ON GOODRICH TIRES.



SEAGRAVE COMBINATION HOOK AND LADDER AND HOSE, DAVENPORT, IA.



CHIEF JOHN F. HEALEY OF DENVER ON "SAFETY TREADS."



WHITE COMBINATION ON SILVERTOWNS, TERRE HAUTE, IND.

hour under full load, it being equipped with a 40-h.p. 4-cylinder motor and mounted on 37 by 5 Goodyear pneumatic tires. It is of the worm-drive type and also carries a full quota of fire-fighting equipment.

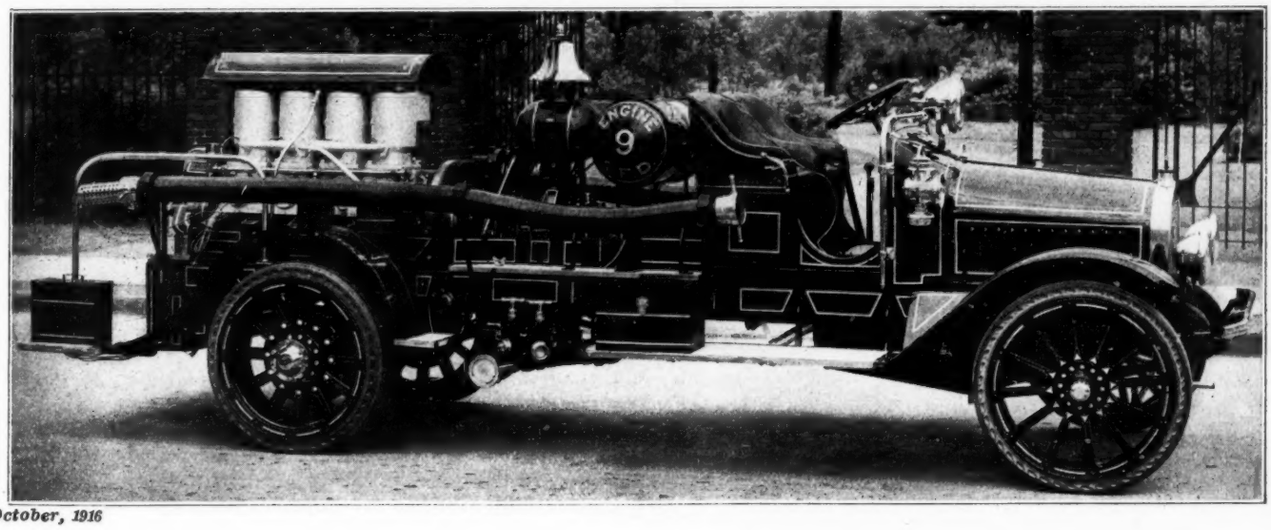
New Mack Pumping Engine

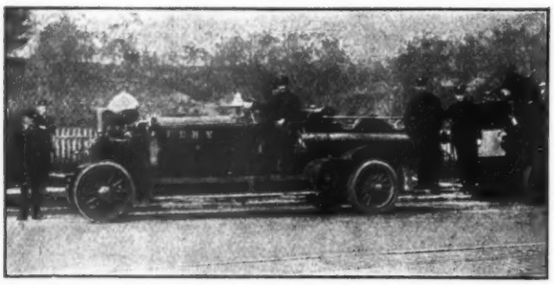
On a 1½-ton worm-drive Mack chassis, 144-inch wheelbase, the Schenectady fire department has mounted a 4-cylinder Schenectady Westinghouse 4-cycle, 6-inch bore by 7-inch stroke gasoline pumping engine in connection with a rotary pump. The engine is mounted on a sub-base which is attached to the frame. The motor is started by a Westinghouse starter. The motor developes about 60 to 65-h.p. Capacity discharge per minute is 732 gallons. With just one stream working it will throw the water 210 feet and with all three streams working it will throw the water 180 to 190 feet each. The longest distance they ever pumped was one stream 1,600 feet. Last winter, with the thermometer registering 15 to 17 below zero, the pump worked for 7½ hours without stopping, throwing two streams of water, each thru 800 feet of hose. On this particular fire the two steam engines which were working alongside of the Mack apparatus continually froze up and they had all they could do to keep one feeble stream apiece on the fire.

It took $40 worth of fuel to keep the steam engines working the 7½ hours, whereas the Mack did more than double the work on 13 gallons of gas and two quarts of oil, at a cost of a trifle over $3. The engine and equipment weighs a trifle over 4,000 pounds. The job is geared 7¾ to 1 and has attained a speed of 32 miles per hour with this ratio. It is very powerful and had very little difficulty in plowing thru the snow last winter, which was the severest they have had in that section in twenty-eight years.

The hose used is 3-inch and 2½-inch. For the first 250 feet next to the engine the 3-inch is used; from that on the 2½-inch is used.

The gasoline engine and equipment were formerly mounted on a horse-drawn apparatus and the change-over was made by the chief engineer of the Schenectady fire department.





AHRENS-FOX PUMPING ENGINE IN NEW YORK ON GOODRICH TIRES.

Motorizing Horse-Drawn Equipment

The passing of the horse in fire department work is inevitable. The quicker, surer methed of transporting fire apparatus on motor equipment has been the means of saving many lives and millions of dollars in fire losses in American cities during the past year.

"The constant care which horses require," says Geo. W. Cushing, sales manager for the Federal Motor Truck Co., "the expense of feeding, shoeing and veterinary services, together with a fast depreciation under hard service in the cities and comparatively higher cost of maintenance in the smaller towns where the alarms are less frequent, have always been large factors in the rapid changing over of this equipment to the motor, which requires very little attention and is of absolutely no expense, except when in actual operation.

"The transition from horse-drawn to motor fire equipment need not be necessarily very expensive as was demonstrated by the city of Albany, N. Y., which not long ago took an old combination hose and chemical horse-truck, made slight and inexpensive changes in the model in order to make it conform closely to several new pieces of recently purchased motor fire apparatus, added a few small accessories and had the whole adapted to a Federal motor chassis. As a result the city of Albany now has in its old truck a new, strictly modern unit which is strong, reliable, speedy and up to the minute in every respect.

"Many other cities thruout the country have motorized their fire departments in the same manner and today are enjoying all the benefit and economy of motor apparatus that otherwise possibly would have been beyond their reach financially, or at best would have cost them two or three times as much."

In many cases the cost of changing over has been even less than in Albany, because without making any changes whatever in the body equipment they have simply transferred it to a motor truck chassis, involving only a few hours' labor of some local wagonmaker and a small amount of timber for bolsters, sills, etc. The effect is wonderful not only in appearance and efficiency of the machine, but in the men whose duty it is to respond to the alarm.

One of the first cities in this country to adopt this practice was Lynn, Mass., which, like Albany, has a population of some 100,000 people, and is thoroly up-to-date in every respect. Its fire department is now completely motorized and includes six motor chassis, on which have been mounted hose-chemical and turret-truck bodies and equipment. Chief Edward E. Chase says his trucks are giving the best of satisfaction and the saving to the taxpayers has been several thousand dollars.

How different this foresight from that of other municipalities where horse-drawn equipment which, with a few small changes, could have been made the equal of any, has been discarded as junk or traded in at a very small proportion of its actual worth. We do not believe that this has been a wilful waste of money on the part of the men who have handled these matters, but due solely to the fact that they do not realize what very satisfactory and efficient motor apparatus may be made from their present horse-drawn equipment, by simply transferring it to a fire chassis.

MUNICIPAL ENGINEERING will be very glad to furnish instructions and estimates for making changes of this character to any city or fire company that is interested in obtaining the maximum fire protection at a minimum expense.

NOTE THE CHIEF'S MOST ACTIVE HELPER, STANDING TO HIS LEFT.

Unusual Record Made by Motor Fire Engines

A remarkable showing was made recently at Chicago during a competitive test of motor fire engines. An engine equipped with a double-action piston pumping unit succeeded in delivering a stream of water at the roof of the Masonic Temple (354 feet above street level), at a nozzle pressure of 230 lbs. per square inch.

The machine making this record is a distinctive design, the multiple pump being mounted at the extreme front of the chassis, directly in front of the motor. The clutches and transmission elements are separate and power is derived from both ends of the engine's crankshaft.

One of the most interesting points about the engine is the method used to cool it at the same time it is driving the pump. A series of looped tubes is attached to a bronze junction box and extended into the suction chamber. As the water from the radiator circulates thru these pipes, it is cooled by the

volume being discharged from the pump. This cooling process can be regulated by either increasing or decreasing the flow to the loops. This is both convenient and efficient.

The car, which is made by the Ahrens-Fox Fire Engine Company, of Cincinnati, O., has a wheel base of 171 inches. Its engine is capable of developing 100-h.p. and a road speed of approximately 30 miles per hour.

Alcohol a Substitute for Gasoline

By Dr. F. E. Young, Canton, O.

Only a few years ago gasoline was an outcast, a commercial waif, a foundling without a friendly doorstep to receive it; today it is King of the Road and shares public interest with "war brides" and other favorites of the commercial world. So rapid has been the increased demand for gasoline that the question of either increasing the supply or finding a suitable substitute has engaged the attention of many experts. Practical men think that the day for gasoline under 25 cents is fast passing and even higher prices may be looked for.

Ultimately there must be found a substitute, and alcohol looks most promising. That will be another necessity of life for the farmer to furnish.

Since 1910 the number of automobiles in use has been multiplied by six and now there are 2,250,000, with about a million added annually. There are about 300,000 motor boats and 700,000 gasoline engines doing farm and factory work.

The demand for gasoline is increasing by leaps and bounds, while the supply of crude oil is actually diminishing. A year ago the great Cushing oil field in Oklahoma was producing over 300,000 barrels of petroleum daily; now it is turning out less than 100,000, higher in gasoline than any other oil in the world.

Before the war we were exporting about 100,000,000 gallons and now about four times that amount annually, about 40 per cent. of the entire production. The United States produces about 65 per cent. of the petroleum and gasoline of the world.

While the production of crude oil has decreased, the supply of gasoline has been increased by new and improved methods of manufacture and by lowering the quality, so that instead of 4 per cent., a yield of from 20 to 40 per cent. is now obtained, of 58 to 60 deg. test instead of the former 72.

The earlier development of kerosene for lighting purposes and the Civil War tax on alcohol drove a colored alcohol mixture used as a lighting fluid from the market. The kerosene oil at first was so volatile that many fires and explosions occurred, and the light boiling fraction had to be taken out. At first they took off only from 2 to 4 per cent. of this gasoline, which they ran into the nearest stream, where it was not only a waste but a nuisance and a menace.

Inventors found methods of utilizing it in the gasoline lamps and stoves and other uses, but the production had to be held down until the internal combustion engine appeared, just in time to offset the introduction of natural gas for household purposes.

Shortly the automobile began to increase the demand until the infant terror of the oil industry has pushed King Kerosene from the throne and has now become the Czar of the whole empire of petroleum commerce and there are few who do not stop at the sign of the garage pump to pay him tribute.

The element of distribution is most important in any motor fuel to come into general use. Gasoline, produced in large quantities only at certain centers, must be transported long distances, to many points of distribution. The present efficiency and economy of gasoline distribution are simply marvelous. You can find a supply at nearly every cross roads, at almost every farm house and there is hardly a port into which the motor boat may chance to poke its nose, where it will not find a supply of this fuel awaiting the demand of the consumer.

A substitute, however, that can be made in any locality, from native material at small factories, will not need such an extensive and elaborate system of distribution nor extended transportation.

Alcohol can be produced wherever any form of vegetable matter can be obtained; in cities and densely populated localities the demand for motor fuel is the greatest, and fortunately the materials for making it from market, trade, and factory waste are most plentiful.

The largest alcohol producing plant in the world is now being built at Baltimore, Md., to take, at a cost of less than $4 a ton, the waste molasses from the West India sugar factories, heretofore run into the water to get rid of it, but now to be utilized, the entire output of alcohol for the coming two years being already sold to the warring nations of Europe. The cost of working will be less than $3 per ton, making the entire cost $7. The yield per ton of molasses is from 150 to 180 gallons. Alcohol is now worth about 65 cents per gallon, a profit of about $100 per ton of molasses.

Cities are destroying thousands of tons of garbage at great expense that would yield, by proper treatment, from 10 to 15 gallons of alcohol per ton, besides other valuable by-products, sufficient to pay for the reduction, leaving the alcohol as clear gain.

New Orleans being the principal port of entry for the banana trade has 2,000 tons of banana waste yearly to dispose of, which is rich alcohol material, but is now dumped into the water along with the city garbage. The sugar factory and cannery waste, the farmers' cull fruit and potatoes, the lumbermen's and pulp-mill waste should all be utilized. About 1,000,000 tons of wood pulp are made in the United States and Canada yer year. The woodsman wastes about one-half in chips, stumps, tops, and culls. The pulp mill

wastes about one-half of its receipts of wood in the removal of the bark, knots and heart wood. About half of the wood actually treated is dissolved and washed away in the waste liquors, so that 7 tons of wood are destroyed to get 1 ton of pulp.

From 15 to 20 gallons of ethyl alcohol can be made from a ton of wood waste, or over 100,000,000 gallons of alcohol, besides other valuable by-products from the total wood pulp waste. The lumber industry probably wastes as much more. Broom-corn and sugar-cane seed and cotton stalks can all be utilized. The vast kelp beds of the Pacific ocean that are to be harvested for the manufacture of potash will at the same time furnish an immense supply of alcohol.

So long as alcohol is made only from whole grain at large central distilling plants, or its manufacture from otherwise waste material, as the waste molasses, is controlled by the same interests that produce the gasoline, the production can be held down, so that the price may be held up.

The column still is continuous, has great capacity and concentrates the alcohol to the required strength at one operation, but it is in the control of the same interests, and the government requirement of 180 deg. proof or 95 per cent. pure, has heretofore required the use of that still. With the old pot still, at least three distillations are required to make 95 per cent. alcohol, so it cannot compete with the improved still.

Process and apparatus have been perfected whereby alcohol can be made of the required strength by small or medium sized plants from cheap and otherwise waste material found in every locality. The saving in cost of material, transportation of the material to the distant distilling plant, and return of the alcohol to the point of consumption, will give the advantage to the small or local alcohol distilleries. It is to such plants that we must look for the production of a sufficient supply to bring down the price of alcohol so as to compete with gasoline. This was exactly what was contemplated by the United States Congress when it passed the Industrial Distilleries and Denatured Alcohol Acts. Releasing industrial alcohol from the internal revenue tax was meant to encourage the manufacture so that it would become plentiful and therefore cheap, as is the case in some foreign countries.

That alcohol is the best substitute for gasoline as a motor fuel, is well shown by the United States Agricultural Department and Bureau of Chemistry in a number of bulletins for free distribution. Alcohol can be used in the gasoline engine without any change in the engine, but for regular use it should be given more pressure in order to secure the greatest efficiency. It can be mixed with gasoline in any proportion; it is not explosive and should it become ignited the fire can be easily extinguished with water.

The high cost of alcohol is the only thing that prevents it becoming the universal motor fuel. Each community can now make its own alcohol, which will solve the distribution problem, at the same time that it utilizes its waste materials. Industrial alcohol and other by-products afford a great opportunity for conservation and the profitable employment of capital.

Cost of Quarry Blasting

The blast made recently at the quarry of the Colorado Portland Cement Company, Portland, Col., with Monobel No. 6, shows that excellent results can be obtained with this explosive in quarry work.

The quarry face at Portland is from 39 feet to 49 feet high. The stone consists of homogeneous layers of limestone varying in thickness from 6 to 28 inches and separated by thin layers of shale varying from nothing up to 6 or 8 inches thick. The stratification is flat and the quarry floor practically level.

The blast consisted of 44 holes, arranged in four rows, each hole drilled 2 feet below the quarry floor level.

The charge of powder in the first row was figured for 2¼ cubic yards of stone per pound, there not being any burden in front at the bottom. Holes in the rear rows were loaded for 2 cubic yards per pound of explosive, to obtain a better shattering effect.

The following summary gives in detail the cost of preparing and firing the whole blast:

Number of holes	44	
Spacing average	20 ft.	
Burden average	20.6 ft.	
Depth average	45 ft.	
Tons of rock broken	61,182	
Cubic yards	30,213	
Cost of drilling (labor)		$ 261.89
Cost of drilling (power)		24.00
Total cost of drilling		$ 285.89
Total feet of hole	2,094	
Cost per ft. of hole (drilling)		$ .1317
Cost per ton of rock (drilling)		.0064
Charge of powder per hole	265 lbs. to 425 lbs.	
Amount of Mon. powder in shot	14,850 lbs.	
Amount of Giant powder in shot	100 lbs.	
Cost of 44-42 ft. fuses @ $0.1848		$ 8.13
Cost of 9-36 ft. fuses @ $0.1632		1.47
Cost of Mon. @ $0.125 including freight		1,826.25
Cost of Giant @ $0.115 including freight		11.50
Cost of shot (powder and fuse)		1,852.39
Cost of shot (drilling and loading)		325.64
Total cost of shot		$2,178.03
Cost per ton of rock (powder and fuse)		$ .0302
Cost per ton of rock (drilling)		.0046
Cost per ton of rock (loading)		.0006
Total cost per ton of rock		$ .0354
Number ft. of powder in all holes	1,294	
Number pounds of powder in shot	14,850	
Number of pounds of powder per ft. of hole from 5⅝-in. bit	12.25	
Amount of rock broken per pound of powder:	4.0 tons. 2.03 yds.	

Results:

Shot appears to have broken up very good.

Motor Vehicles in Minneapolis

The city of Minneapolis owns 58 motor vehicles and makes monthly allowances for maintenance of 12 individually owned automobiles. They are distributed among the departments as shown in the accompanying table:

	Owned by city	Owned by individuals for which a monthly allowance is made for maintenance
City Engineer's Department	12	2
Water Works Department	6	..
Fire Department	10	..
Police Department	10	..
Street Lighting Department	..	1
Board of Education	3	6
Board of Charities and Corrections	6	2
Library Board	2	..
Park Board	9	1
Total	58	12

Fire Department Notes

J. H. Harrison, chief of the Brunswick, Ga., fire department, has been a fireman for thirty years and has been chief of the department since 1910. Since becoming chief, he has discarded the horses for motor apparatus, thus effecting considerable saving for the city. The report of the Fire and Building Permits Committee states that a feed bill of $868.86 will be replaced by a gasoline and chemical bill of $200.00.

Vacuum Street Cleaning in St. Louis

For sixty days in June, July and August the street division of the Department of Streets and Sewers experimented with a vacuum street cleaner plant, consisting of two machines, a patrol machine for cleaning the main part of the street and a gutter machine for cleaning the gutters.

C. M. Talbert, director of the department, has made a report upon the work done, from which, and a letter from the director to the editor, the following is abstracted and extracted:

Close observations made of the work of the machines warrant some conclusions and a comparison of the cost of the work with the method in use for some years past. Among the things which can be said in favor of the work of the machines, are:

First: A very complete removal from the street surface of all foreign matter and particularly what is known among those who study street refuse as "dust," this being the very fine and at times impalpable particles which lie close to the surface of the pavement and which have been found by bacteriologists to be the germ-carrying part of street refuse.

Second: By cleaning these streets every night, the department has been enabled to eliminate street sprinkling entirely. There has not been on the streets of the downtown section any sprinkling since about the first day of July. Those street sprinklers made from six to eight trips each business day over each of the downtown streets and their very slow movement and the fact that they must take the center of the street in order to properly cover the surface, complicated the traffic problem.

Third: This absence of the street sprinkler leaves a dry, clean surface for traffic and in these days when probably 75 per cent. of this traffic is automobile, it adds greatly to safety by eliminating the tendency to skid; the report of the police and others interested in traffic shows that there has been a great diminution of accidents from such causes during the past thirty days. There must also be considered the general inconvenience to pedestrians from the sprinkler sprays.

Fourth: As would naturally be expected, the use of the vacuum system has materially reduced the labor necessary to keep clean the sewer inlets and catchbasins. The superintendent of sewers reports a reduction in material removed of about 35 per cent. This proportion will be increased still further as the system becomes established and it is anticipated that the expense of cleaning sewer inlets will be reduced about 50 per cent. It has also very materially reduced the number of complaints of stopped or blocked sewers.

Fifth: From an examination of material taken from the streets, it does not appear that the asphalt surfaces are sensibly worn by the brooms.

Sixth: The more complete removal of dust and dirt from the streets reduces the work of the white wings and while they have not been reduced in number during the experimental period, it is certain that some reduction could be made. It will always be necessary in any system of street cleaning to have white wings in the congested district during the business hours.

Among the disadvantages, is the inability to use the machine under any other conditions than when the roadway and gutter are perfectly dry. During our experimental run of sixty days there have been six nights on which work could not be successfully done. It would appear to me likely that during the rainy season, that is, from the middle of March to the first of June, it would be necessary to use some form of street flushing at least twice per week. This is largely a matter of guess, as no two seasons are at all alike. There have

ELECTRIC DRIVEN STREET SWEEPER AND SPECIAL WAGON FOR RECEIVING SWEEPINGS TO TRANSPORT TO DUMP. WHEN IN OPERATION THE TWO UNITS ARE CONNECTED AND THE AIR PASSAGE, ENDS OF WHICH ARE SEEN NEAR TOP, IS CONTINUOUS.

DATA COVERING SWEEPINGS ON 140 BLOCKS. JUNE AND JULY

Date	JUNE —1916— Gutter Machine Cubic Yards	Center Machine Cubic Yards	Date	JULY Gutter Machine Cubic Yards	Center Machine Cubic Yards
June 1	3.37	1.80	July 1	3.08	2.18
2	4.00	1.90	3	2.68	3.19
3	3.92	2.56	4	4.00	2.11
5	Rain		5	2.48	1.08
6	Rain		6	2.48	2.00
7	1 hour only		7	3.08	2.18
8	4.48	4.38	8	3.08	2.18
9	3.37		10	3.78	2.18
10	3.68	.22	11	3.68	3.06
12	4.58	4.58	12	3.37	3.96
13	4.36	3.18	13	2.50	3.78
14	2.92	2.18	14	3.40	3.98
15	4.18	2.18	15	3.06	2.77
16	3.08	2.18	17	3.48	2.58
17	3.38	2.18	18	3.51	2.78
19	4.18	3.38	19	3.51	2.18
20	3.68	2.18	20	3.48	3.68
21	3.37	3.37	21	3.06	2.18
22	Rain		22	2.78	2.03
23	2.18	3.92	24	3.08	2.00
24	3.18	2.18	25	3.62	2.78
26	4.99	2.48	26	3.68	2.79
27	3.51	2.18	27	2.18	1.75
28	2.98	2.98	28	2.98	2.40
29	2.62	2.48	29	2.98	2.40
30	2.48	2.00	31	3.68	3.08
	78.49	54.49		82.69	67.28

SUMMARY

June Cleaning **132.98** Cubic Yards removed, or **226,066** Pounds
July Cleaning **149.97** Cubic Yards removed, or **254,949** Pounds
Total **282.95** Cubic Yards or **481,015** Pounds
June Cleanings **22** average per cleaning **6.04** cu. yds. or **10,268** Pounds
July Cleanings **26** average per cleaning **5.77** cu. yds. or **9,809** Pounds
Total **48** average per cleaning **5.89** cu. yds. **10,013** Pounds

REMARKS

On July 3rd it rained until 9 P M. Machines started cleaning at 1:30 A. M.
On July 12th it rained from 4 to 6 P. M. Machines started cleaning at 8:15 P. M.
On July 19th there was a heavy rain fall of .81 inches from 2 to 3 P M. Machines started cleaning at 7:30 P. M.

been periods wherein the vacuum cleaner could undoubtedly be used a good portion of the time, even in the month of March, which is one of our most troublesome months on account of the prevalent high winds. It must be borne in mind that the same rain that would stop the work of the vacuum cleaner would have a tendency to wash the dust into the sewer or if not heavy enough for that, to eliminate it thru a natural sprinkling.

The owners of the machines desire to contract for the street cleaning and have refused to sell or lease any of the machines, basing their refusal upon their claim that they are more interested than anything else in the success of the machine and that their men are trained especially for this work; that failures in other machines of like character that have been placed upon the market from time to time have been largely due to placing their operations under men who are not vitally interested in their success.

They propose to charge 80 cents per 10,000 square feet of street actually cleaned, with no payment for days when work cannot be done.

At the present time, we are cleaning approximately 174 great squares, which would cost $140. Assuming 120 days of work for the remainder of the fiscal year, we have $16,800, which equals the cost for cleaning the entire district six nights per week during favorable weather for the remainder of the year.

As against this payment, to clean the streets during this period by our ordinary process of flushing once each week, the cost would be 34 times $124, or $4,216, or a net increase in cost to the street division of $12,600.

To be credited in crews picking up papers, etc....$1,800.00
Withdrawal of sprinkling taxes for eight months (reversion to Municipal Revenue)..... 4,000.00
Cost of water for sprinkling and flushing..... 1,500.00
Saving in inlet cleaning..... 400.00

Total $7,700.00
Leaving a net increase of municipal expense for this cleaning of $4,900.00

In conclusion, it may be said that during this period since the sprinkling wagons have been removed and the vacuum cleaning instituted, there have been no complaints of dust or dirt in the congested district and this department has received numerous verbal commendations upon the changed conditions as well as having on file a number of letters from merchants, stating that conditions so far as dust is concerned have been improved.

A contract on the terms given is recommended by the Director.

Since the report was made some examinations have been made of the materials collected by the gutter machine and the patrol machine and the details of the materials collected by each, which shows that approximately 60 per cent. of all street dust is found within 8 feet of the gutter and that by far the greater part of the coarse dirt is collected from the gutter. Three classes of districts are compared as follows:

First: On thorofares traveled practically exclusively by automobile, street dust passing a 200-mesh sieve amounts to 5.8 per cent. and that retained 94.2 per cent.; total, 100 per cent.

Second: With mixed automobile and horse-drawn vehicles, steel tired, dust passing a 200-mesh sieve amounts to 10.9 per cent. and that retained 89.1 per cent.; total, 100 per cent.

Third: On streets used almost exclusively by horse-drawn rubber-tired vehicles, dust passing a 200-mesh sieve, amounts to 30.6 per cent. and that retained 69.4 per cent.; total, 100 per cent.

SHOWING LAYERS OF STREET DIRT AS DEPOSITED IN BOX BY THE AIR, WHICH CARRIERS THE SWEEPINGS TO THE BOX.

It would appear from this that the very fine dust is collected on streets that are subjected to steel tire traffic and the steel shoes of horses, and that the automobile traffic tends rather to leave the dust in coarse particles.

The preliminary bacteriological examination showed that the gutter dust contained 270,000,000 germs per cubic centimeter and that the dust from the center of the street contained 249,000,000 germs per cubic centimeter. The city bacteriologist is making a further detailed study of the samples submitted.

The work will be continued for a period of at least three months and additional interesting information is expected. The Way-Cleanse Company, of Sandusky, O., own the machines and are operating them on the St. Louis streets.

The accompanying table shows the results of each day's work with each machine on the days in June and July on which it was operated.

Proportioning Waterproofing Material in Concrete

The usual specification for using a paste waterproofing states that a certain amount by volume shall be mixed with a certain number of parts of water. This mixture is then to be used in place of clear water for tempering the cement and aggregate.

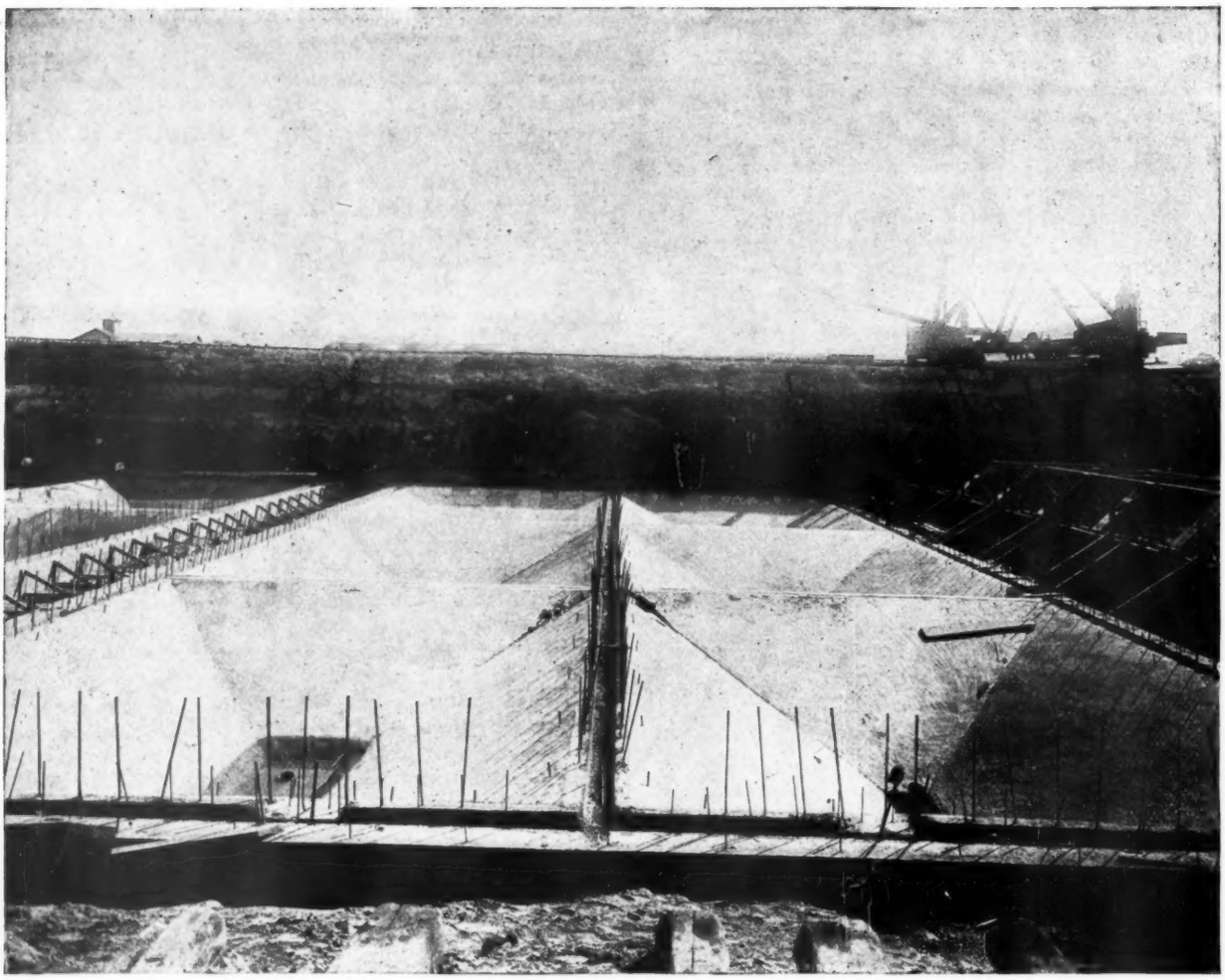
Since the amount of water used for each yard varies from 25 gallons to 40 gallons, so also will the amount of waterproofing per cubic yard vary. For example, we will take a waterproofing that is used in the proportion of one part by volume to 36 parts by volume of water. If 1 gallon of waterproofing was mixed with 36 gallons of water there would be a total of 37 gallons of waterproofing mixture to be used the same as clear water for tempering the cement and aggregate. Assuming that the waterproofing weighs 8 pounds per gallon, then every gallon of mixture would contain 1/37 of 8 pounds, i. e., 0.216 pounds of waterproofing. The contractor using 25 gallons of water per cubic yard will use 25 times 0.216, or 5.4 pounds of waterproofing, in every yard, while the contractor using 35 gallons of water will use 35 times 0.216, or 7.5 pounds of waterproofing, in every yard. This would mean that one man is using too little or the other too much. It demonstrates that uniform results cannot be obtained by mixing the waterproofing as specified above. It is necessary, instead, to specify that a certain number of pounds of waterproofing shall be used per cubic yard and then introduce that number of pounds regardless of variable factors.

A method has been worked out by which this may be accomplished easily and simply, which has been used very successfully on several large operations, including the Rochester sewage disposal plant, Bevis Hill reservoir at Schenectady, New York, Omaha reservoir, and others.

One of the most interesting was the Rochester sewage disposal operation, on which Trus-Con waterproofing paste, concentrated, was used. There were several large concrete tanks which had sloping bottoms. A concrete of moderately dry consistency (28 gallons of water per cubic yard) had to be used on the bottoms, and the side walls were poured with a concrete of wet consistency (35 gallons of water per cubic yard). Mr. Poole, chief engineer, was very anxious that the concrete should be uniformly waterproofed and, of course, this could not be done by mixing one part of paste with 36 parts of water. Also, the contractors had bid a certain amount per yard for waterproofing and they had to be assured that they would not use a greater amount than that specified. It was decided that 6 pounds of paste per cubic yard was sufficient for this job, and it was introduced as follows:

The head was knocked out of a barrel of paste and half of it removed to an empty barrel. About five gallons of water was added to the half barrel of paste and the mixture was stirred thoroly. The object of this stirring with a small amount of water is to prevent the formation of lumps, which are liable to occur if all the water is added at first.

When this has been thoroly stirred to a smooth consistency, more water is gradually added while stirring until the barrel is full. This gives a thick, creamy mixture containing one part of paste and one part of water. The paste weighs 8 pounds per gallon. So every gallon of one-to-one mixture contains 4 pounds of waterproofing paste. Since 6 pounds of paste was to be used in every yard, 1½ gallons of the one-to-one mixture was necessary. The mixers used were of ¾ yard capacity, and so in every batch there was used ¾ of 1½ gallons, or 9/8 gallons, of the one-to-one mix. A measure was made which held just the correct amount for one batch, and the workman filled this and dumped it into each batch as the cement and aggregate were added. This insured that 6 pounds of paste would be introduced into every yard of concrete, regardless of the number of gallons of water used. Each night



ROCHESTER SEWAGE DISPOSAL PLANT. SHOWING SLOPING TANK BOTTOMS WHERE RATHER DRY MIXTURE HAD TO BE USED, WATERPROOFED WITH TRUSS-CON WATERPROOFING PASTE, CONCENTRATED. C. ARTHUR POOLE, SUPERVISING ENGINEER.

the number of yards of concrete and the number of pounds of paste used were accounted, giving a check on amount. This was a good safeguard. On the first day's run it was found that each batch was running a little over ¾ yard, and on the next day a slightly larger amount of the paste mixture was added.

When this specification was first advocated there was fear that the waterproofing would not uniformly distribute itself when added in such a concentrated form directly into the eye of the mixer. But the method has been used on any number of operations, both large and small, with perfect success. Even when the concrete is hand mixed this method gives perfect results. It stands to reason that if a concrete mixer will make a homogeneous mass of cement, sand, stone and water, that it will also uniformly distribute a waterproofing which in itself is mixable with water.

This method is very easy to use. All that it is necessary to know is the number of pounds to be used per yard and the capacity of the mixer.

This method has several advantages over other methods. A barrel of one-to-one mixture will last a half day on an ordinary operation, which means a saving because an extra laborer will not be required for mixing the waterproofing. The job can be figured to within a few pounds of the amount needed and the contractor can figure his waterproofing bid more closely. The architect or inspector can check the contractor at any time by recording the number of yards of concrete poured and the number of pounds of paste used.

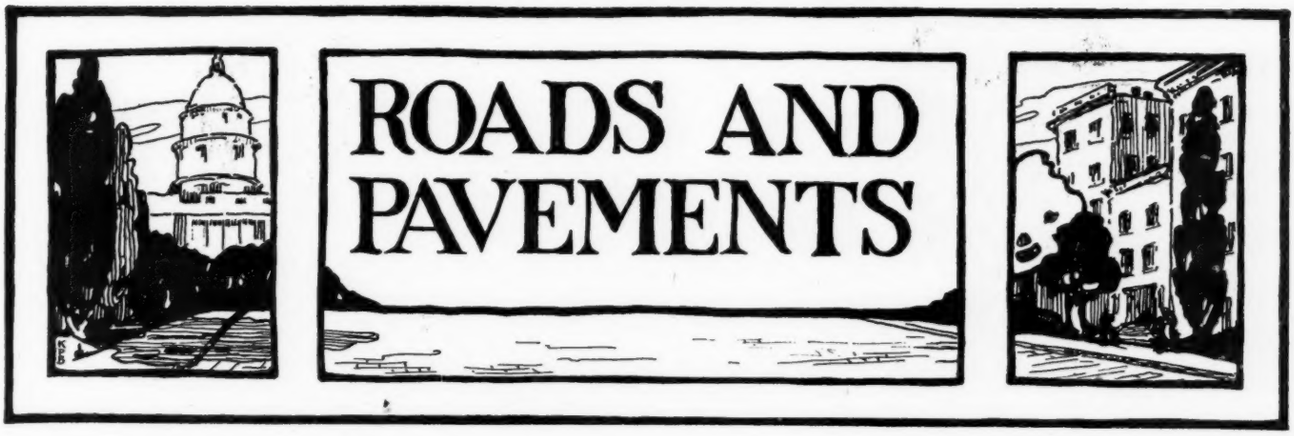
The paste in the one-to-one mixture does not separate out very rapidly, but it should be stirred every time before taking out a measure full. Usually one stroke of the paddle is sufficient to keep a uniform mixture.

An illustrated description of the design of the Rochester sewage disposal plant will be found on page 181 of the May number of MUNICIPAL ENGINEERING, to which reference may be made for further details. We are indebted to *Structural Conservation* for the cut and data.

Motor Traffic in Seattle

In Seattle, Wash., official checks at seven points, taken at stated intervals, showed 5,160 motor vehicles in 1911 and 17,568 in 1915, an increase of 222 per cent. in motor traffic. Horse-drawn traffic decreased from 8,266 in 1911 to 3,261 in 1915, or 60.5 per cent. The total increase in traffic is 55 per cent.

The state records show that 9,540 licenses have been issued for Seattle motors, 1,329 of which are auto trucks in use by owners, and 305 are auto trucks for hire, or nearly 17 per cent. of the motor-driven vehicles owned in the city are motor trucks.



Street Railway Track Laying

The Chicago surface lines are relaying their double track line on Lawrence avenue, between Kedzie and Cicero avenues, in preparation for the paving of the street. A 24-inch water pipe is being laid also as rapidly as the track construction is completed. The old roadway was almost impassable except on the street railway tracks, which had 5-inch light rails laid on sawed yellow pine ties set about 2 feet between centers. Most of these ties, when taken up, are in very fair condition. The street railway area was paved with rather small and irregularly shaped granite block on sand cushion, the upper surfaces of which had rounded off so as to make the pavement quite rough.

To remove the old roadbed the old rails are first lifted up by means of jacks inserted under them, and they bring most of the ties and paving blocks with them. The old tie rods are knocked out, the rails are pulled out one by one by a team, and the stones and ties are thrown out, requiring very little work with the pick, the lifting of the track by the jacks giving sufficient looseness to the blocks and their foundation.

The subgrade is then plowed and shoveled out into wagons. The subgrade is then trimmed flat and rolled with a 4 or 5-ton roller running in the trench. The new sawed yellow pine ties are laid on blocks 4 inches thick, 2½ feet between centers, and the new grooved 7-inch rails are spiked to the ties. Then blocks are placed under the rails, about three to each rail length, and the blocks are removed from under the ties. This leaves a full open space under the ties 4 inches high, into which concrete is filled and carried up to a level about 1 inch above the top of the ties. The blocks under the rails are left in to hold the rails up until the concrete has set, and then they cannot be removed. Universal cement, sand and broken stone form the concrete. When special temporary filling is required for cross-overs and tracks to use during construction, crushed slag of three sizes, 1½ inch, 1 inch, medium and dust, was used, tamped into place, with some sand for filler.

The north track was first constructed and put into use, and then the south track. In joining up the concrete for the second track with the older concrete, a slight valley was left about half way between the tracks. In this valley a copper wire cable for return current was laid and covered with cement mortar.

The rails of each track are connected with strap ties, with the flat side vertical, spaced about 6.5 feet apart. A sand cushion of about 1¼ inches is spread on the cured concrete and the blocks are laid on this. The blocks of dark gray granite, most of them, and about 6 by 6 by 8 inches in size, are laid on this cushion carefully to give as uniform a top surface as possible. They are carefully cut and make joints less than ½ inch in width, and are fitted in carefully between the strap ties, so that the surface of the completed pavement does not show the location of the ties.

The blocks are grouted with cement, are then thoroly tamped into bearings, and the joints are again grouted and the grout swept in until the joints are thoroly filled. Sand is then scattered thinly over the surface.

The rail joints are laid opposite, the joints being made with tie plates about 18 inches long, bolted with one bolt to each rail. The cross-ties are set about 12 inches apart at these joints so that the tie plates ordinarily extend over cross-ties at both ends. The spaces at the rail joints are left unpaved until the rail joints are welded, and then the pavement is completed. It is scarcely possible to find the junctions of the rails anywhere in the completed structure.

Most of the work is done by the Chicago Surface Lines by day labor. The Citizens' Construction Company has a contract for removing the earth to make room for the new foundation. The company uses a small concrete mixer, mounted on a car, which follows up the concrete work on the track being laid as rapidly as is necessary. Materials are brought in on small dump cars hauled by electric motors and dumped at convenient places along the line. One line is kept open for regular passenger travel, delays of traffic being but little more than those due to operating a fairly busy line on one track without turnouts for a mile or so.

Concrete Roads and Streets

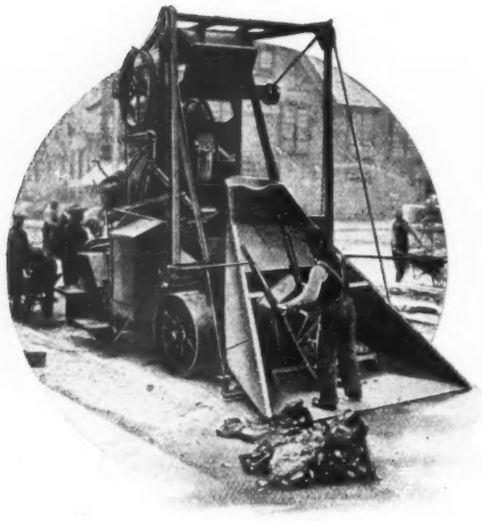
Figures recently furnished by the Road Bureau of the Portland Cement Association indicate that in five states contracts have so far been awarded this year for 1,000,000 or more square yards of concrete pavement. The states and figures are as follows:

Illinois	1,412,789
Ohio	1,391,430
Indiana	1,342,095
New York	1,150,304
Iowa	1,000,291

Michigan, Wisconsin, California and Texas are making good strides toward the million mark, as indicated by the following figures, although it should be mentioned that the records of California were not complete when totals were made up.

Michigan	606,112
Wisconsin	546,203
California	448,749
Texas	530,470

It is interesting to know that most of the yardage in Iowa is for city streets, while the greater portion of the yardage in other states is for country highways.

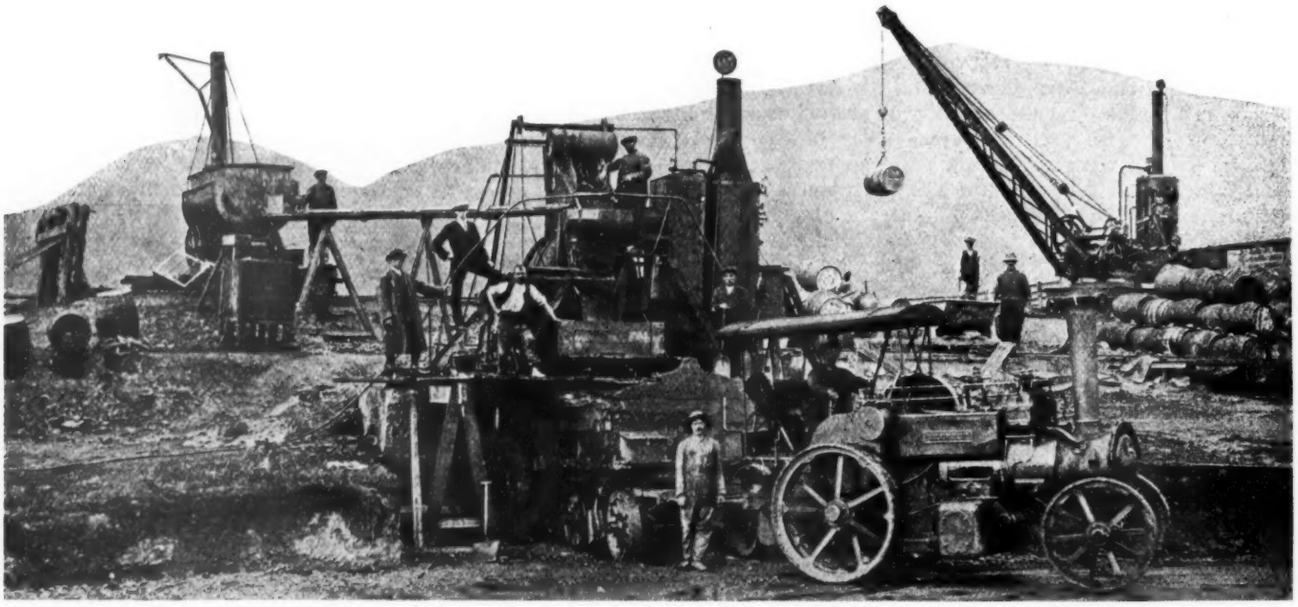


Tar-Macadam Paving in County of Clackmannanshire, Scotland

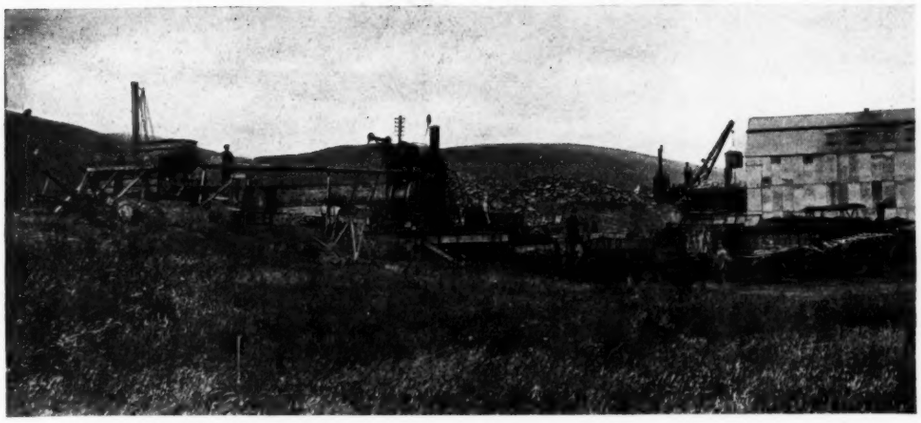
This article comprises a most instructive account of the manufacture of tar-macadam at the county depot of Clackmannanshire, Scotland. Mr. Jno. C. Alford, the county surveyor, furnishes some interesting figures as to costs, and we would especially draw attention to the fact that no young men are employed, the average age being fifty-seven years. This has only been possible owing to the careful way in which the plant and general arrangements have been planned by him, and the county is certainly to be congratulated on the general efficiency and low cost of production, especially in view of the natural difficulties to be contended with and the good wages paid.

The county council have recently abandoned their old quarry, which was situated at the west end of Tillicoultry, a town lying on the southern slope of the Ochil Hills, which form the northern boundary of Clackmannanshire. The isolation of this old quarry from the neighboring ones, together with the natural barriers surrounding it, which caused long detours to be made in order to reach the principal highways of the county, and the fact that the town folk passing thru the town, were responsible for the council deciding to look around for a spot more central which would be within easy access to the neighboring quarries, which supply the rubble and other metal for the road work, and which would also shorten the journeys of the tractors to reach the chief roads of the county.

Eventually the present depot, known as Bankhead stone depot, was set up, this occupying a two-acre field alongside the North British Railway, Devon Valley line, at Bankhead, about ¾ mile to the west of the old depot. There was an old, disused railway line running across this field, and owing to certain mining operations years ago the ground sloped in different directions from the embankment of the rail line, and thus offered admirable facilities for the installation of ma-



WITH THIS ARRANGEMENT AND BY THE VALUABLE ASSISTANCE OF THE CRANE IT WAS FOUND THAT ABLE-BODIED MEN COULD BE DISPENSED WITH TO A GREAT EXTENT, AND THE NUMBER OF MEN REDUCED 50 PER CENT., THESE BEING VERY ESSENTIAL POINTS JUST NOW. ONE THOUSAND TONS OF TAR-MACADAM WORK WAS DONE RECENTLY AT THE COUNCIL DEPOT BY THIS NUMBER OF MEN, WHOSE AGES WERE AS FOLLOWS: ONE, 78 YEARS; THREE, 72 YEARS; FIVE, 65 YEARS; TWO, 60 YEARS; ONE, 55 YEARS; FOUR, 50 YEARS; ONE, 35 YEARS, IN ALL, EIGHTEEN MEN—I. E., FOUR DRIVERS AND FOURTEEN LABORERS.



STEAM CRANE AT CRUSHER PLATFORM DELIVERING RUBBLE.

THE ARRANGEMENT OF KOEHRING HOT MIXER AND TAR-BOILER, AND THE HAULING OUT OF LOADED TRAILER, AND THE EMPTY TRAILER GOING INTO POSITION FOR REFILLING.

chinery and plant, owing to the various levels obtainable, which is always a desirable feature in setting up plant, and particularly of the type used in road-material manufacture. The platform of the stone crusher in use is a foot above and to the southeast end of the embankment. Below the crusher screen are fitted hoppers, which are only used when the broken metal is to be stored for future use. In addition to the hoppers there is a chute with folding doors, spaced at every 2 feet, down which the metal slides and fills at any point, the trailer standing below. When the chute is required the upper portion of the chute is formed by lifting the plate side of the hopper nearest the chute; this, when dropped, forms the side of the hopper. The metal from the crusher drops into small trucks which run along a 2-foot gage bogie line to the loading bucket of the Koehring hot mixer, into which the metal is tipped for the manufacture of tar or any sort of macadam desired.

As the manufacture of tar-macadam was not contemplated when this plant was set up, it was necessary to devise some arrangement to mix the various sizes of metal for this purpose. This was accomplished by carrying out a new hopper from the side of the existing hopper to take the three sizes to a point in the chute where the metal drops into the end of trailer and discharges the contents into a bogie on a side line. This arrangement worked very well, not interfering with the original arrangement, as a shutter in the new hopper, when thrown back, allowed the metal to drop freely into the end of trailer as before. When the treated metal from the Koehring has filled one trailer the steam tractor hauls this out of the way, and an empty trailer is placed in position, while the loaded one is hauled to the road, emptied and returned.

The North British Railway have laid a siding on the north side of the west field, with enough track to hold twelve wagons comfortably. Parallel to this siding, about 12 feet above it and 21 feet from center to center of rails, a 4-foot 8-inch gage line has been laid down, on which travels a 2-ton steam locomotive crane having a 21-foot sweep. This crane lifts all rubble out of wagons by means of iron boxes with bottoms worked on the trigger principle, and delivers it either on the bank or at the crusher when work is in progress. The whole of the unloading and delivery work is performed by the crane driver and one man. The crane is also able to run along the rails to the coal shed and deliver coal where required.

After work had been in progress some time it was found necessary to have the Koehring hot mixer set up on another level for the manufacture of tar-macadam. As stated above, the formation of the ground lends itself admirably to this purpose. The position finally decided on was the farther end of the bogie line from the crusher, the loading bucket being just below the level of the rail, so as to feed direct from the crusher by a tipping bogie. This position insures the metal from crusher being quite clean.

The hot mixer was set up on two concrete walls, and on the discharge side of mixer the soil was cut away to a depth of 6 feet to admit a trailer to be backed under the small platform, on which was a small bogie which received the tarred material from the discharge chute, and then tipped the contents into the trailer beneath, thus saving much time and labor usually expended in shoveling the material into wagons or trailers.

The tar used in the manufacture of tar-macadam was heated in a 250-gal. tar-boiler, set up on the end of the crane line and packed up high enough to allow the boiling tar to run down a 25-ft. chute, with a slope of 9 inches in this distance, into the measuring tank of the Koehring machine, and when ready the required batch of tar was run direct into the mixing drum. The crane fed the boiler with tar barrels, and

BOGIE IN POSITION AFTER TIPPING STONE INTO KOEHRING MIXER LOADING BUCKET.

THE TAR-BOILER WITH RUN FOR HOT TAR FORMED OF HOUSE RHONES AND MEASURING BOX.

THE DRIVER IN THE ACT OF RAISING THE BUCKET.

also lifted up the barrels of fuel oil for the oil furnace on the machine, and placed them alongside the engine ready to be strained before allowing the oil to enter the fuel tank.

By the thoro organization of this plant the whole process of receiving the rubble in the wagons in the siding, delivering it at the crusher, making correct-size metal, conveying it to the mixer, converting it into tar macadam, delivering into trailers for dispatch to the roadside, goes on continuously, no one part having to wait or being dependent on the other.

We believe it will be very interesting for reads to know the amount of labor required in the whole process, including the conveying, laying, spreading and rolling of the tarred stone on the road, and we give the surveyor's figures herewith:

One crusher-engine driver, who fills up his spare time helping at the jaws.

One man at the jaws of the crusher.

One man at hoppers, and one man to help him with bogie.

One man at the chute.

One engine-driver at the Koehring machine making tar-macadam.

Two men at box taking delivery of tar-macadam.

One man attending to the fires and water.

One man at the tar-boiler attending to temperature and supplying tar.

One driver at the tractor.

One roller driver and four men spreading metal.

One crane driver and man.

Nine-Hour Day.

The steam crane conveys to crusher 50 tons of rubble.

The crusher makes 40 tons of metal, 5 tons chips, and 5 tons dust.

The Koehring tar-mixer makes 40 tons of tarred stone, but is capable of manufacturing 60 tons in nine hours if fully worked. The output is limited to the supply in this case.

The tractor conveyed a distance of two miles 40 tons of tarred stone.

The cost of the day's work:

Cost of rubble, 40 tons at 3s 5d	$ 33.07
Wages of crane driver per day	1.17
Wages of loader per day	1.07
Wages of crusher engine driver per day	1.07
Wages of man at jaws	1.07
Wages of three men at hoppers and screen	3.21
Wages of Koehring driver	1.65
Wages of four men at Koehring	4.76
Wages of one tractor driver	1.70
Wages of one roller driver	1.17
Wages of three men with roller at 4s 2d each	3.13
Wages of one night watcher	.73
Cost of 336 gallons of tar	24.20
For all the engines—	
Cost of 1½ tons of coal	5.08
Cost of oils, fluid, 15 gallons	1.10
Cost of oils, paraffin, 8 gallons	1.17
Cost of cylinder	.28
Cost of oils compound	.41
Cost of oils machine	.12
Cost of oils grease	.30
Two tons of ¾-in. chips for spreading, at 4s 6d	2.18
Cost of wear of tools for spreading on road	.73
Wear and tear of all machinery	2.40

THE HOT MIXER ON THE JOB.

Gloves and overalls for men at tar	.97
Contingencies	9.14
Total cost of one day's work	$106.48

The superficial area of road, 2 miles from place of manufacture, treated with 40 tons of tar-macadam turned under the system adopted in the county, is 320 sq. yds., at a cost of $106.48, which works out at 33½ cents per square yard. This is not allowing any credit for the 5 tons of whin dust manufactured daily, which will be used as a binding material for the ordinary water bound macadam road.

Machinery.

The 2-ton steam crane (portable) with rails was supplied by Messrs. Butters Bros., Glasgow, engineers.

The crusher was supplied about twenty-eight years ago, and is still very serviceable.

The engine driving the crusher is about twenty years old, and the motor steam tractor has been in use for nine years. Both are still quite serviceable.

The Koehring hot mixer was purchased from Messrs. A. A. Byrd & Co., London, in August, 1914, and was used on the roadside last year for the manufacture of tar-macadam for the road improvement work of that year, which was done expeditiously and well. The advantage in using it in its present ideal position was the reduction on number and quality of labor that was required to work it on the roadside. The number of men employed on the roadside was thirteen, while four men—and not necessarily able-bodied men—can do the same work in its present condition.

The county surveyor speaks very highly of the mixer, as it does its work most efficiently, and he stated that he did not see how the manufacture of tar-macadam as done by it could be improved upon. With the present arrangement of having the tar-boiler in an elevated position the process is as clean as it is possible to make it; in fact, there is no visible sign that tar-macadam is being manufactured till the stone is ejected from the drum into the bogie, which passes over and delivers it into wagon. Mr. Alford further stated that he was more than satisfied with the hot mixer, and that his expectations have been fully realized.

We have no doubt that our readers, and particularly road engineers, will be interested in this record of work done in a very difficult district, and with such success as regards cost and the type of labor used.

Georgia Has a State Highway Commission

On September 19, under the provisions of the law recently passed by the legislature, the Georgia State Highway Board was organized, with the State Prison Commission as a nucleus. Judge T. E. Patterson was selected as chairman of the highway department and Capt. Goodloe Yancey as secretary. The other members of the prison commission are R. E. Davison and E. L. Rainey. These four, with S. W. McCallie, state geologist, Prof. C. M. Strahan, head of the engineering department, University of Georgia, and Prof. R. D. Kneale, head of the engineering department of the Georgia Technical School, form the highway board.

The legislature gave the board very little power and no appropriations, so that it cannot yet take advantage of the National appropriations. The National law gives the state three years, however, in which to comply with its conditions, and the first work of the State Highway Board will be to work out a system of state work and of co-operation with the counties of the state, so that when the legislature makes the necessary appropriations and gives the board the necessary authority, it can start the work at once.

E. W. James, chief of maintenance in the U. S. Office of Public Roads, was present at the organization meeting and showed what would be necessary for Georgia to do to comply with the federal act and receive its share of the National appropriations.

Meeting and Paving Demonstration of National Paving Brick Manufacturers Association

The National Paving Brick Manufacturers' Association holds its annual meeting at Terre Haute, Ind., at the Deming Hotel, October 5, at 10 o'clock a. m. On October 6 a demonstration of the method of constructing monolithic brick pavement will be made, to which engineers and state, city and county officials have been invited and are expected in large numbers.

The company will leave the Deming Hotel at 9 a. m., October 6, for a short inspection of old brick streets in Terre Haute, especially that on South Sixth street, which is still in very excellent condition and now some twenty-five years old.

At 10 o'clock the party will take the interurban railroad to Paris, Ill., where the older streets will be inspected and a demonstration of the methods of construction of monolithic brick pavement will be given from start to finish.

On return to Terre Haute a banquet will be served.

Paving in Manhattan Boro

The chief engineer in charge of highways of the boro of Manhattan, New York City, Eugene W. Stern, has made his report for 1915, the first year of his incumbency. It shows the improvements made in the organization of the department and the work done by it in interesting form.

The boro has but 479 miles of streets in its 22 square miles of area, of which 248.92 miles are paved with sheet asphalt, 115.33 with stone block, 55.58 with block asphalt, 34.50 with wood block, 4.5 miles with macadam, and but 20 are unpaved. There are also 0.63 mile of viaducts. Of the paved streets, 335.25 miles are old enough to be under the maintenance charge of the boro, the remainder being still under contractors' construction guaranties. But 10.60 miles of street were paved in 1915, three-fourths of which were asphalt.

The congestion on some streets is excessive. Over Fifth avenue at Forty-second street 1,149 vehicles have been counted in one hour bound south, as compared with a maximum of 900 for the Strand, London, and 600 on the Boulevard des Capucines, Paris. On 49 miles of New York streets traffic is over 10,000 vehicles a day, and on 75 more it is from 7,000 to 10,000. The openings made in the streets in the year numbered 22,000, requiring replacement of 132,000 square yards of pavements.

The report recommends the replacement of about 40 miles of old pavements with new each year for the next ten years, at a cost of about $3,000,000 a year, a less amount being required thereafter as compared with an appropriation of $1,000,000 in 1914 and one of $600,000 in 1915.

Maintenance of 335.25 miles or 6,875,870 square yards of pavements by the boro cost $440,666. The cost per square yard was 8.1 cents for stone blocks, 6.9 cents for asphalt, 5.3 cents for macadam and 4.4 cents for wood block. These figures indicate that in general the kinds of pavement have been selected with very reasonable success for the service required of them.

Fall of Quebec Bridge Span

The new bridge across the St. Lawrence river at Quebec is apparently doomed to bad luck. The fall of the suspended span before its arrival on its permanent supports on the ends of the two cantilevers, while serious in its consequences in loss of life and property and a source of heavy expense and loss of time in replacing the span, is no such indictment of the bridge engineering profession as was the former failure of one of the great cantilevers while under construction. That failure involved a complete re-design and reconstruction of much of the bridge.

The reconstruction on the new design has progressed to the point of closing the opening between the projecting ends of the cantilevers with an ordinary truss bridge supported on those ends. This truss had been completed, floated out on barges under its proposed final position, hung from the suspender links from the cantilever ends above, and lifted a few feet on its way up to its place in the bridge.

It is supposed that one of the cast blocks which were bearings for pin connections of the ends of trusses at right angles to each other broke and thus threw the weight of the structure upon two diagonally opposite points of support, there being four such points in all. The motion accompanying threw one or more of the truss ends out of the stirrups in which they rested. The unequal stresses, for which no provision had been made, caused the collapse of one or more of the panels of the trusses, and the whole span fell into the river, carrying with it the men at work upon it.

While the loss is by no means as serious as that in the first accident, it is said that it will cost some $600,000 and a year's time to replace the truss and mount it in position.

A Correction

In an article on Granite Paving in Brooklyn, published on page 92 of the September number of MUNICIPAL ENGINEERING, a typographical error in the report, which was followed in the article, caused the statement that the Koehring mixer employed in the work had a capacity of 100 square yards a day. Apparently this should read 100 square yards an hour. The error is of course self-evident to any one acquainted with the capacity of the mixers used in laying concrete base for pavements.

Street Improvements in Minneapolis

Minneapolis, Minn., is contemplating a large amount of paving of arterial streets under the Elwell law, under which two-thirds the cost is assessed against benefited property. Of the present gross bonded debt of the city, $24,127,200, the sum of $2,679,027.49 is for street improvements under that law, two-thirds of which is to be paid by the property owners. Of this sum, $935,550.45 is for improvements on the arterial lines of streets, nearly all of it on property in the south and east districts. Some probable new arteries, due to expected suburban developments, are included in the list.

MISCELLANEOUS

Association Meetings

Oct. 9-13, at Robert Treat Hotel, Newark, N. J.—American Society of Municipal Improvements. Charles Carroll Brown, secretary, 702 Wulsin Bldg., Indianapolis, Ind.

Oct. 10, 11, at the Hollenden Hotel, Cleveland, O.—Central States division of American Water Works Association. R. P. Bricker, secretary, Shelby, O.

Oct. 10-15, at Visalia, Cal.—League of California Municipalities. H. A. Mason, secretary, Pacific Bldg., San Francisco, Cal.

Oct. 11, at Vernon, B. C.—Union of British Columbia Municipalities. H. Bose, secretary, Surrey Center, B. C.

Oct. 11-13, at Independence, Kans.—League of Kansas Municipalities. C. H. Talbot, secretary, Univ. of Kan., Lawrence, Kansas.

Oct. 12-14, at Everett, Wash.—League of Washington Municipalities. H. A. Brauer, secretary, Univ. of Wash., Seattle, Wash.

Oct. 13, 14, at Street Cleaning Department Bldg., New York City—Society for Street Cleaning and Refuse Disposal. J. R. Buchanan, secretary, Municipal Bldg., New York City.

Oct. 16-21, at Detroit, Mich.—National Safety Council. W. H. Cameron, secretary, Cont. & Coml. Bank Bldg., Chicago, Ill.

Oct. 18, 19, at Red Wing, Minn.—League of Minnesota Municipalities. R. R. Price, secretary, Univ. of Minn., Minneapolis, Minn.

Oct. 23, at Cincinnati, O.—National Highway Exposition.

Oct. 24-27, at Cincinnati, O.—American Public Health Association. S. M. Gunn, secretary, Boston, Mass.

Oct. 26-28, at Hillsboro, Tex.—League of Texas Municipalities. H. G. James, secretary, Univ. of Tex., Austin, Tex.

Nov. 15, at Urbana, Ill.—Illinois Municipal League. J. A. Fairlee, secretary, Univ. of Ill., Urbana, Ill.

Nov. 16-18, at Nashville, Tenn.—Fire Marshals' Association of North America.

Nov. 20-22, at Lewiston, Mont.—Montana Municipal League. E. S. Judd, secretary, city clerk, Billings, Mont.

Nov. 20-23, at Springfield, Mass.—City Managers' Association. O. E. Carr, secretary, Niagara Falls, N. Y.

Nov. 21, at Springfield, Mass.—Massachusetts Civic League. E. T. Hartman, secretary, 3 Joy St., Boston, Mass.

Nov. 22, 23, at Springfield, Mass.—Municipal Research Workers. L. D. Upson, program committee, Detroit, Mich.

Nov. 22, 23, at Springfield, Mass.—Training School for Public Service. Charles A. Beard, supervisor, 2161 Broadway, New York.

Nov. 23, 24, at Springfield, Mass.—Civic Secretaries' Conference. Howell Hart, secretary, Milwaukee, Wis.

Nov. 23, 24, at Springfield, Mass.—Massachusetts Federation of Planning Boards. A. C. Corney, secretary, Cambridge, Mass.

Nov. 23-25, at Springfield, Mass.—National Municipal League. C. R. Woodruff, secretary, 705 N. A. Bldg., Philadelphia, Pa.

Dec. 27-30, at Columbus, O.—American Statistical Association. C. W. Doten, secretary, 491 Boylston St., Boston, Mass.

Dec. 26-31, at New York.—American Association for the Advancement of Science. L. O. Howard, secretary, Smithsonian Inst., Washington, D. C.

Jan. 20, 1917, at Kansas City, Mo.—Western Paving Brick Manufacturers' Association. G. W. Thurston, secretary, 416 Dwight Bldg., Kansas City, Mo.

Jan. 23-25, 1917, at New York.—American Wood Preservers' Association. F. J. Angier, secretary, Mt. Royal Sta., B. & O. R. R., Baltimore, Md.

Feb. 5-12, 1917, at Mechanics' Hall, Boston, Mass.—American Road Builders' Association. E. L. Powers, secretary, 150 Nassau St., New York.

Prizes for Engineering Papers

The Hydrated Lime Bureau of the National Lime Manufacturers' Association, Arrote building, Pittsburg, Pa., will pay $100 for the best letter of not more than 500 words on the use of hydrated lime in concrete, the letters to be received on or before 9 a. m., December 6, 1916. The terms of the contest are given in a circular issued by the bureau, which can be had on application. Other prizes for $50 and $25 are also offered, and $5 will be paid for each other paper retained for publication.

The engineers' subdivision of the Chicago Association of Commerce offers three prizes for $50, $30 and $20 for the three best papers not exceeding 3,000 words in length on any one of the subjects, "Engineering and Civic Progress," "The Engineer of the Future," and "The Business Relation of the Engineer to the Commercial World," papers to be received at its office, 10 South LaSalle street, Chicago, Ill., on or before November 1, 1916. Details will be given by the secretary of the association.

Car Shortage Becoming Serious

Last year, with the crop shipments to shipping ports for foreign countries, cars were hard to find, but this year, with the added increases in demand for cars for transporting materials for manufacture, building and engineering construction and for machinery for all purposes, as well as general merchandise, the shortage in cars is becoming very acute, and many manufacturers are now notifying their customers that they must order in advance of their requirements to insure delivery on time, even tho their own facilities are sufficient for any reasonable calls. They emphasize four points, which are thus expressed in a circular letter from the Universal Portland Cement Company:

"Keep shipments coming. Order shipments well in advance of future needs. When possible place orders for carloads 'any size.' Unload cars immediately upon receipt." In other words, keep things moving so that the cars will waste no time standing still or acting as storage.

The Newark Convention of the American Society of Municipal Improvements

The twenty-third convention of the American Society of Municipal Improvements bids fair to be the largest convention the society has ever held, tho the last three conventions have each broken the record for attendance. The program sustains the reputation of the society for keeping its discussions fully up to date, being specially timely on activated sludge and Imhoff tank sewage treatment, street lighting, garbage and refuse collection and disposal, wood block, granite block and concrete paving, all these subjects being treated by those directly engaged and prominent in making history in these lines.

Newark has an exceptional situation among interesting examples of municipal and other public improvements, and the local committee has made ample provision for showing them t odelegates in large and small parties under competent guidance.

While this number is issued immediately before the convention, it may not be too late to recommend our readers in municipal employment to attend. The society has had an addition of new members during the year of over 20 per cent., and there will be a considerable number of names to be passed by the board at the convention, which have come in during September.

Why the A. S. M. I. Goes to Newark

The man from Newark was in Chicago trying in stentorian tones to convince a friend that Newark, N. J., was a quick-rising sort of town not mentioned in the baking powder ads, when a stranger butted in and offered a few favorable remarks to sustain our citizen's contention.

"Thanks," said the Newarker, "you seem to know our town. When were you there last?"

"Only three weeks ago," replied the stranger assuringly.

"—," ejaculated the man from Newark, "you ought to see it NOW!"

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places, as follows:

Oct. 11, 12: Engineer, Indian service, at Canton Asylum, S. D., and Kiowa Agency, Okla., at $720 a year.

Technical Association Notes

The Northwestern Association of members of the American Society of Civil Engineers, the Minnesota sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers; the Minnesota Surveyors' and Engineers' Society; the Engineers' Club of Minneapolis, and the Civil Engineers' Society of St. Paul have formed the Minnesota Joint Engineering Board, with representatives from each of the six societies, to bring about closer co-operation. Geo. W. Rathjens, of St. Paul, is the secretary of the board.

Personal Notes

S. H. Bothwell has been promoted to the office of city engineer of Webster Grove, Mo., a suburb of St. Louis.

Elwood G. Ladd, Florida Life building, Jacksonville, Fla., is in charge of the office of the Chicago Bridge and Iron Works, which covers the states of Florida, Georgia and Alabama.

Arthur J. Sweet has opened offices in the Palace Theater building, Milwaukee, for consulting practice in steam, electrical and illuminating engineering, and makes street lighting problems a specialty.

George A. Taber, consulting engineer, recently with Nicholas S. Hill, has associated himself with Clarence D. Pollock, and they will practice under the firm name of Pollock & Taber, with offices in Park Row building, New York City. Their specialty is municipal engineering, including pavements, water supply, sewerage and sewage disposal.

Publications Received

Second annual report of Country Roads Board of Victoria, Australia. W. Calder, chairman, Melbourne, Aust.

Annual report of North Yakima, Wash., for 1915. N. A. Gilman, city engineer.

Electrolysis and its Mitigation, by E. B. Rosa, chief physicist, and Burton McCollum, electrical engineers, is No. 52 of The Technologic Papers of the U. S. Bureau of Standards, Department of Commerce, Washington, D. C. Earth resistance and its relation to electrolysis of underground structures, by Burton McCollum and K. H. Logan is No. 26 of the same series. Protection of Life and Property against Lightning, by O. S. Peters, Assistant Physicist, is No. 56 of the same series.

A Good Roads Bulletin for Illinois Public Schools, issued by F. G. Blair, State Superintendent of Public Instruction, gives much valuable information on how to keep earth roads in the best condition possible, with some statement of the advantages of macadam road surfaces.

Bulletin 347 of the U. S. Department of Agriculture is a description of "Methods for the Determination of the Physical Properties of Road-Building Rock," by Frank H. Jackson, Jr., assistant testing engineer in the Office of Public Roads and Rural Engineering.

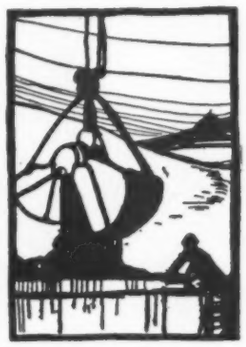
Report No. 111 of the State Bureau of Municipal Information of the New York State Conference of Mayors and Other City Officials is on Municipal Clean-up Campaigns, various methods and plans adopted by American cities, organizations, samples of literature used, and programs. Denver, Philadelphia, Cincinnati, Jersey City, Toledo, Cleveland, Chicago, Kewanee, Ill., Muskogee, Okla., Brooklyn, Spokane, Paterson, Salt Lake City, Dallas, Pensacola, Bay City, Ore., Antlers, Okla., Denison, Tex., Rochester, Cornwall, N. Y., Galveston, Akron, O., Wichita Falls, Tex., Charleston, S. C., Utica, N. Y., Larned, Kan., Saratoga, Chattanooga, Covington, Ky., New York, Reading, Pa., Richmond, Va., St. Louis, St. Paul, Tyler, Tex., Minneapolis, Tifton, Ga., Ft. Worth, Lockport, N. Y., Boston, Mass., are cities contributing to the report, and there are others which have not responded to requests for information.

The report of Oliver McClintock, delegate of the Pittsburg Chamber of Commerce to the Dayton meeting of the National Municipal League, on the subjects of municipal home rule and the commission-manager form of city government, with special refernce to Dayton itself, has been published in pamphlet form by the Chamber.

Reports of the chief engineer of the Miami Conservancy District; vol. I, synopsis of proposed plan of improvement and process followed in its development; vol. II, real estate descriptions; vol. III, forms of contracts and specifications and detailed estimates of costs, 25 cents each. Arthur E. Morgan, chief engineer, Dayton, O.

Report of division of Sewage Disposal of Columbus, O., for 1915. C. B. Hoover, chemist in charge.

Report of Commissioner of Public Roads of New Jersey for 1915. E. A. Stevens, commissioner, Trenton.



MACHINERY AND SUPPLIES

New Motor Combination Flusher

The Moreland Motor Truck Manufacturing Co., Los Angeles, Cal., has recently delivered a new type of combination sprinkler and flusher to the city of Los Angeles.

In general appearance the unit is not materially different from others in common service. The flushing nozzles, however, of which there are five, each separately adjustable, are mounted at the front of the chassis. Each is controlled by an individual valve, and all of them by a master valve operated from the driver's seat. While traveling at a speed of about eight miles an hour the apparatus is capable of flushing a 60-foot pavement. The sprinkling nozzles are provided at the rear, and at a speed of 10 miles a street 80 feet in width can be sprayed from curb to curb. The tank has a capacity of 1,200 gallons and can be filled in about two minutes. A pump mounted on the chassis delivers the water to the nozzles at high pressure. The truck's propulsion shaft passes thru that driving the pump, for which there is a special clutch and two-speed transmission set, so that both narrow and wide pavements can be cared for properly. At night the machines are used for flushing the streets and in the daytime for spraying them.

Evolution in Armor Plate

We are illustrating three different steps in the evolution of Baker armor plate for joints in concrete pavements.

View (1) shows standard angles having sheared members extending into the concrete on the under side. This was used in the first rural concrete road built by the R. D. Baker Co. for the Wayne County Road Commission in 1909. These joints, four in number, are still wearing very well with a possible exception that the concrete has worn away faster than the steel. The objection to this joint is the high price, owing to the amount of steel used.

View (2) shows the first Baker armor plate having sheared members every foot, anchoring it to the concrete. This plate was 3/16 inch by 21 inches. The manufacture of this plate was discontinued. The experiment showed, as well as observation, that the plates will not wear down as fast as the concrete. Also, being a straight plate, the action of the steel tire in passing over the joint tends to vibrate the concrete back of the steel.

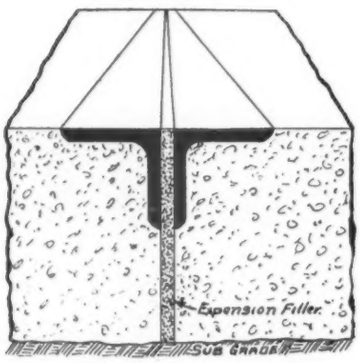
View (3) shows Baker bevel-edged plate employing a minimum quantity of steel. The tendency of traffic is to drive this steel down upon the concrete. This plate, which is ⅛ by 2½ inches, will wear down evenly with the concrete, as roads having it installed have demonstrated. The beveled or turned-over edge reinforces it as the shock of the steel tires comes against it.

Measuring Device for Concrete Mixtures

A method of changing readily the proportion of cement in concrete has been used in Los Angeles, which is very simple in theory. As usual, the various mixtures for the concrete used at different places on the job called for twice as much gravel as sand, and the only variable quantity was the proportion of cement to sand. Measuring boxes of size to suit the mixer used were made, into which the material was discharged thru holes governed by sliding plates, the gravel box being the size of the sand box.

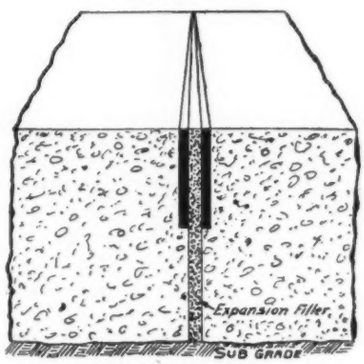
These boxes can be discharged at will into the hopper of the concrete mixer. A third box for measuring the cement was divided into two parts by a permanent vertical partition and sliding plates in each part so that by cutting off portions of the box the amount of cement measured could be varied according to the proportions required. The design of the cement box was not perfect and caused the plant to be very dusty. The ease with which the volume of the cement meas-

(VIEW 1)



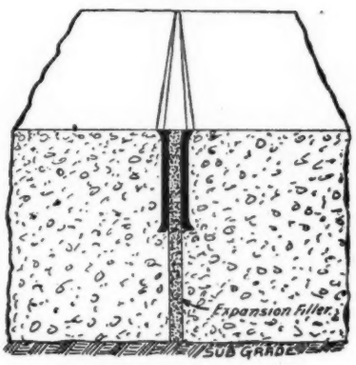
Angle Iron
The first steel protection for expansion joints in a Concrete Road used in 1909.

(VIEW 2)



Straight Baker Armor Plate.
The next step in Expansion Joint Protection.

(VIEW 3)



Baker Bevel Edged Armor Plate.
The last step in Expansion Joint Protection.
Maximum efficiency with minimum steel.

uring box could be changed made changes from one mixture to another possible on short notice, and as frequently as necessary.

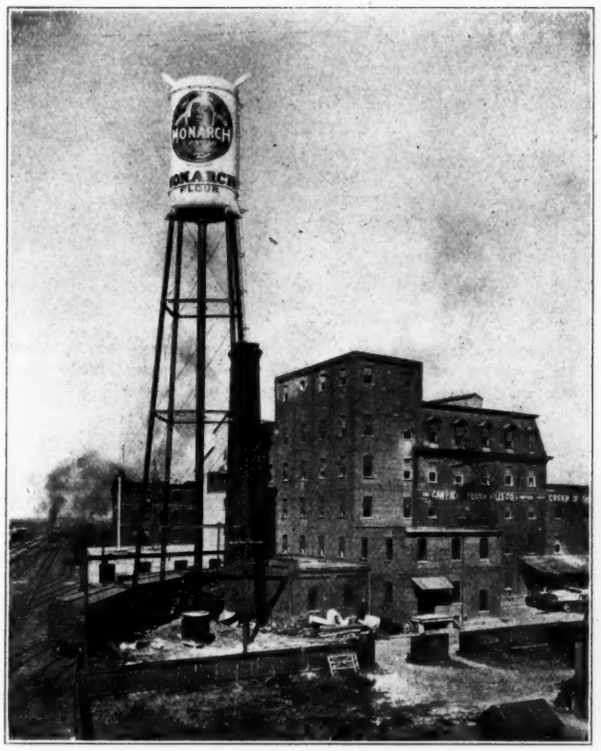
An Unusual Structure

The accompanying photograph illustrates a large elevated water storage tank built for the Campbell Flour Mills Co., Limited, of Toronto, Ontaria. Their flouring mills, which rank among the most progressive in Ontario, were recently equipped with an automatic sprinkler system to provide fire protection and reduce their insurance rates. The tank is used for the storage of water necessary to operate the sprinkler system to provide fire protection and reduce their insurance rates. The tank is used for the storage of water necessary to operate the sprinkler equipment satisfactorily. Altho the installation was made for a private concern, its unusual features make it noteworthy to municipal waterworks engineegs, who readily can see its adaptability to their own civic uses.

The prominent position and great height of the structure renders it peculiarly effective for advertising purposes, and the company has taken advantage of this fact in having the tank built in replica of a bag of flour. The work is built entirely of steel, which material may be readily formed to the shape desired and at the same time insures great strength and unusually long life. The tank was painted and lettered to represent exactly the sack in which the company's product is marketed.

Some idea of the size of this water tower may be gathered from the following data: The tank holds 40,000 gallons of water. The total height of the structure is 152 feet above foundations. The tank itself is 37 feet deep and 18 feet wide, being built oval in cross-section to correspond truly to the shape of a flour sack. The weight supported is over 200 tons.

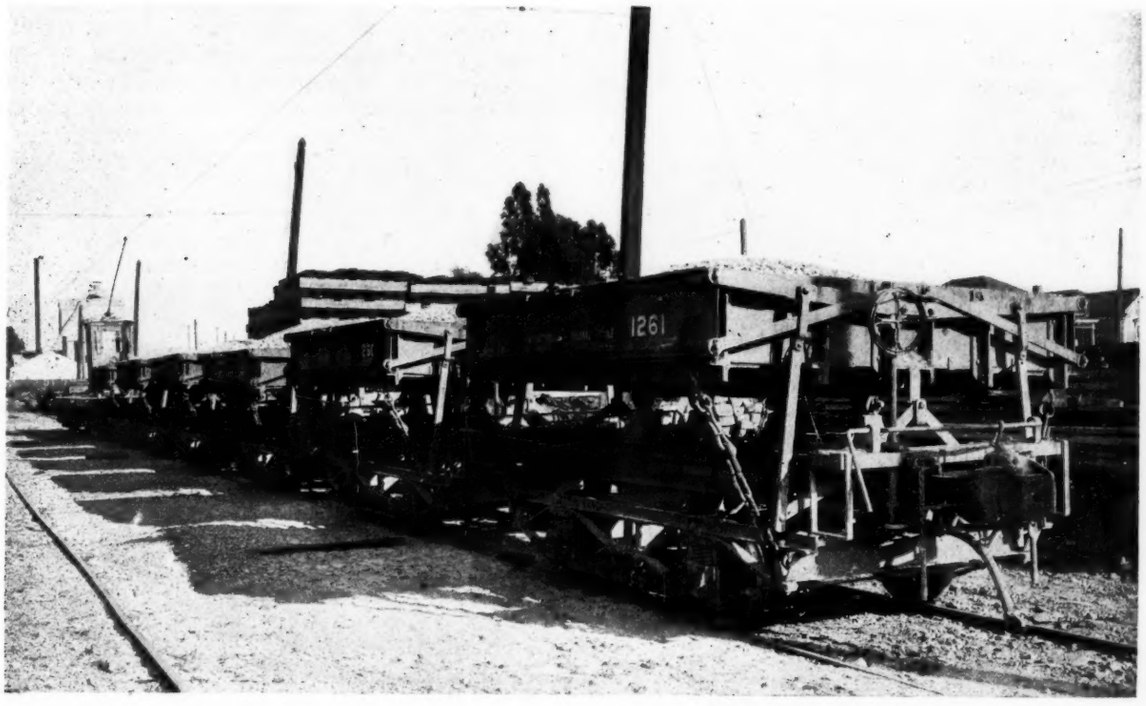
The work was designed and executed by the Canadian Chicago Bridge & Iron Company, of Bridgeburg, Ontario, which makes a specialty of this class of construction. They have also recently constructed in the city of Toronto for the City Dairy Company a similar structure having a tank in the shape of a milk bottle.

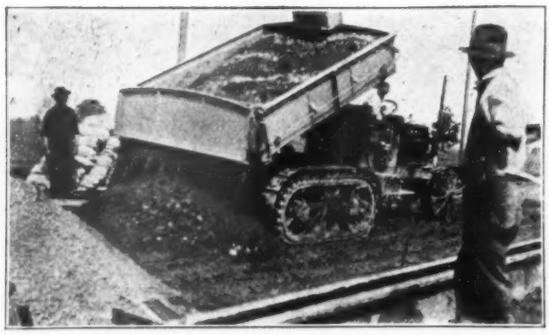


Hauling Hot Asphalt

We are illustrating a loaded train of all-steel, Western 5-yard cars, owned by the San Francisco-Oakland Terminal Railway. They are operated on the streets of Oakland, Berkeley and Alameda, Cal., and used for hauling hot asphalt. These cars are equipped with air brakes and special swivel automatic couplers for taking curves of 30-foot radius. They are built so that they do not leak and have given excellent satisfaction.

TRAIN OF WESTERN 5-YARD CARS USED BY SAN FRANCISCO-OAKLAND TERMINAL FOR HAULING HOT ASPHALT.





ALLIS-CHALMERS TRACTOR TRUCK DUMPING SEVEN TONS OF GRAVEL ON ROADBED OF CONCRETE ROAD. NOTE THE DRIVER OPERATING THE DUMP BODY FROM SEAT.

The Tractor Truck

Generally speaking, the Allis-Chalmers tractor truck combines in a practical way the speed of the auto truck with the essentials required in haulage work where an auto truck is used, viz., traction effort and drawbar power.

The traction effort is produced by a special type of all-steel wheels. The drawbar or pulling power is produced by a high-power auto-truck-type motor. This combination produces a tractor truck of great efficiency in haulage work.

This type of truck carries a body load of seven tons. The body equipment is furnished to meet the requirements of the purchaser's haulage problem.

The large amount of drawbar power developed by the high-powered engine and special type wheels enables hauling of one to four trailers of one to five tons capacity, thereby cutting auto trucking costs 50 per cent. and upwards, according to the number of trailers it is practical to use.

For gravel, sand, crushed stone and brick hauling, a special type of end dump power hoist body is recommended. This body is made of heavy sheet steel, with a device for spreading to desired depth, from 2 to 15 inches. This body is constructed to allow the end gate lowering free of bars or other obstructions, to level with bottom of body, to permit hauling of contractors' equipment, lumber, etc. The capacity of the end-dump body is 5 yards.

The dump mechanism is operated from driver's seat for either spread or pile dumping, and is simple and fast in operation. The spreader device can be set for permanent depth spread, which is a vital feature in road construction work, as in no cases provision for permanent spreading device is made on dump bodies.

An Improved Centrifugal Pump

The development of the steam turbine and the high-efficiency multi-stage centrifugal pump have gone hand in hand, but up to the present, it has not been entirely practicable to reconcile the speeds of the two machines so that each would work at its best efficiency. Heretofore it has been necessary either to reduce the speed of the turbine and sacrifice much of its efficiency, or, else speed up the pump with similar results. To overcome this difficulty, the Cameron Pump Works, of New York, have designed a multi-stage centrifugal pump, known as the "BT" type.

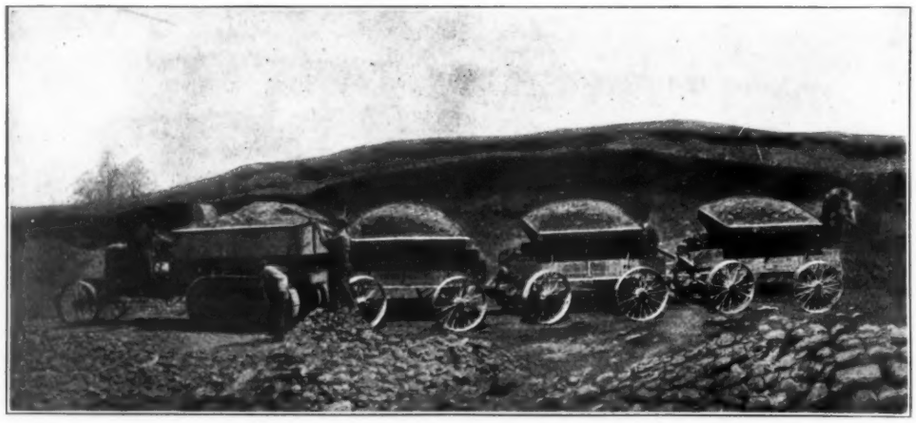
An accompanying photograph clearly shows the construction of one of these three-stage pumps. The high-speed feature is a virtue of impeller design. With the ordinary impeller the diameter cannot be reduced sufficiently to get high speed without sacrificing vane length, and consequently, efficiency for a certain vane length is very necessary in order that the impeller perform its function without excessive loss. Small external diameter and adequate vane length are obtained in this pump by bringing the vanes well down into the impeller hub, at the same time so turning them that the incoming water is guided smoothly and with little loss into the outer portion of the vane, where the velocity is generated that is finally converted into useful pressure by means of the external diffusion vane. Additional advantages in the small impeller are light weight and low fiber stresses in the material.

Detailed Construction.

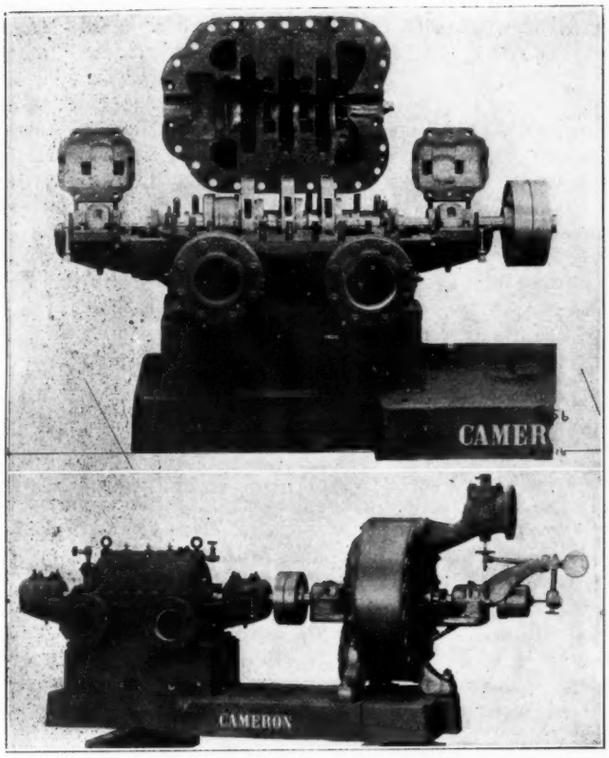
The casing is divided along the horizontal outer line. Both the suction and discharge connections are in the lower half of the casing. The upper half is readily removable, giving full access to the revolving element. There are suitable openings for draining the pump and for displacing the air when starting. Inlet and outlet nozzles can be arranged either on the same or opposite sides—an advantage where pumps are installed in limited space.

The shaft is made of high-grade forged steel, accurately machined and ground, and wherever it comes in contact with the fluid being pumped, it is thoroly protected by bronze sleeves, which prevent the stuffing-box packing from scoring the surface of the shaft.

Each impeller is cast solid in one piece and is of the enclosed type. Surrounding each impeller hub is a pair of rings—one stationary, attached to the casing, and one revolving, attached to the impeller. By the use of double rings instead of a single ring, it is possible to restore the initial tightness of the joint between the low and high pressure sides of each stage without any fitting whatever, whereas a new sin-



ALLIS-CHALMERS TRACTOR TRUCK DRAWING THREE TRAILERS CARRYING THREE YARDS OF PIT-RUN GRAVEL, WEIGHING 3,200 POUNDS TO THE YARD, AND FIVE YARDS IN THE DUMP BODY, MAKING A TOTAL OF FOURTEEN YARDS. NOTE THE ROUGH, RUTTY AND SANDY CONDITION OF ROADBED.



ABOVE: THREE-STAGE BOILER-FEED PUMP, SHOWING INTERNAL CONSTRUCTION AND ACCESSIBILITY OF PARTS.

BELOW: THREE-STAGE BOILER-FEED PUMP DIRECT CONNECTED TO G. E. TURBINE. CAPACITY, 550 G.P.M., 200 LB. PRESSURE, 31,000 R.P.M.

gle ring would have to be of special diameter, and then fitted to the impeller hub or the casing in order to make a tight joint.

The diffusion ring surrounds the impeller at its periphery, altho it is not in contact with it. It contains a series of openings, which receive the water from the impellers at high velocity and by means of gradually increasing area toward the periphery, reduce the velocity into pressure and enable it to advance to the entrance of the next impeller with much less loss of energy than would be the case if the high velocity of ejection were maintained.

Taking Care of the Thrust.

To take care of thrust, which manifests itself in all multi-stage pumps, this pump is equipped with a simple internal hydraulic balancing device. This device consists of a revolving disc attached to the shaft at the inboard or high pressure end. Opposite this disc is a stationary drum of the same diameter. Water at high pressure connects with the space between the disc and the drum, causing the disc to react against the opposing thrust, neutralizing it and holding the rotor in proper relation to the casing. The slight leakage involved in this process is piped back to the suction.

On this pump there are two ring-oiled bearings, self-alining, one located on each side of the casing. The bearing bodies are horizontally split, with removable caps, and the bushings are also split and lined with high-grade bearing metal. Bushings and bearing bodies have a spherical fit, automatically maintaining the alinement of the shaft. The bearings are of ample proportions to prevent heating, and the oil chamber is of liberal capacity. The bearings are supported by strongly ribbed brackets, cast integral with the lower casing, thus counteracting any possible tendency towards even slight vibration. These brackets are located sufficiently distant from the stuffing boxes to permit of adjustment of the glands. Felt washers are provided to prevent oil escaping from the bearings.

Functions of Component Parts.

The stuffing boxes are deep and provided with water seals, consisting of a lantern gland in each box, connected to the water from the discharge side of the pump, thru a concealed passage, so arranged that it can be readily cleaned. The stuffing-box gland is fitted with swing bolts to give quick and easy access to the stuffing box.

When the pump is direct-connected, it is supplied with a shaft-coupling of the flexible type to compensate for slight variation in alinement.

The bed-plate under the pump is of one-piece box construction heavy enough to give a rigid support, and with cross ribs to prevent distortion.

The second photograph shows this pump entirely assembled, and it is claimed by the manufacturers that it occupies less space than the ordinary boiler feed pump of this general type, and that it will give a higher degree of efficiency. Several are now being built for use by the U. S. government.

Texas Using Auto Truck Train

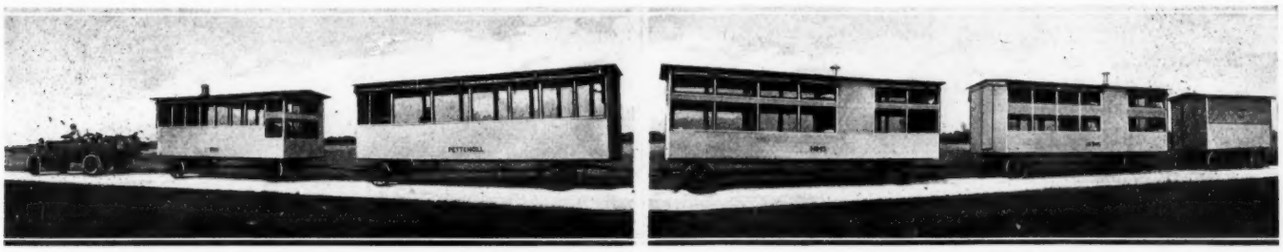
Probably the most modern innovation in "prairie schooners" is now being operated thru the sparsely settled section of Texas by a telephone-construction and repair gang whose work enforces long overland trips where living accommodations are uncertain.

The motor train comprises a tractor and five enclosed cars, two of which are used for sleeping purposes, one for a kitchen, one for a diner, and the car at the rear as a general baggage car in which all the workmens' equipment, except poles, is carried.

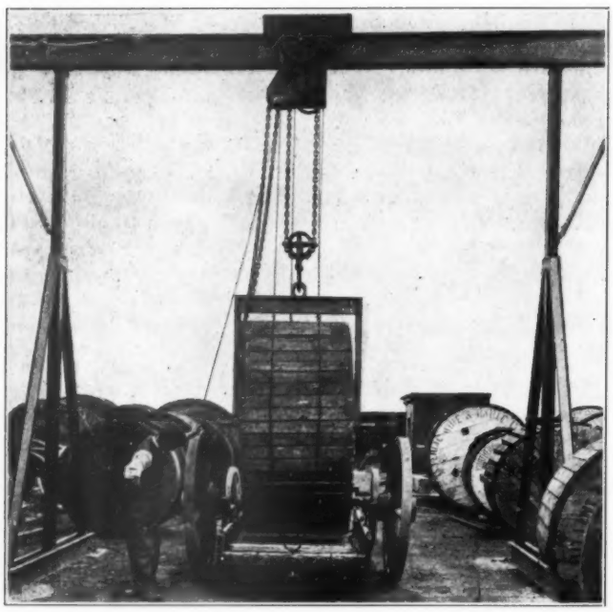
Berths in the sleepers are arranged in double, cross-wise tiers so as to accommodate twelve men to each car, and small stoves heat each car during cold weather. All openings are screened, and the sides are fitted with heavy drop curtains which effectually keep out rain.

The kitchen car is equipped with stoves, a regular sink, shelving for dishes and supplies. In the diner there is a single long table and a butler's pantry with warming ovens in which the food can be kept piping hot until served. Even a telephone is installed at one end of the car.

The complete train idea is that of the Southwestern Telegraph & Telephone Co., of Houston, Texas, and the truck used is made by the Wichita Falls (Texas) Motor Company.



Courtesy of Popular Mechanics.



New Hand Hoist for Truck Loading

The vastly increased adaptation of the motor truck to the varied uses of the general contractor is leading to the invention of numerous innovations in the way of accessory loading and unloading devices. These always are worth the serious consideration of the contractor.

One of the latest devices designed especially for increasing motor truck efficiency by reducing the time of loading and unloading is a new type of hand-operated hoist at the plant of the Toronto, Ont., Canada, hydro-electric system. It is there used for loading and unloading 5-ton rolls of cable.

The hoist, which is of the differential block-and-fall type, is mounted on a small carriage running above a horizontal I-beam, supported on two steel uprights, about 20 feet above ground. This makes it possible for the truck to drive underneath it.

The salient feature of the crane, however, is a patented, automatic lowering device, making it possible for even a 5-ton load to lower itself under gravity. This lowering of the load is accomplished by means of a light hand chain, which is itself made impervious to tampering by an automatic centrifugal governor brake which forestalls a too-rapid descent of the load. This brake is so designed as to permit of the empty hook being pulled down rapidly by hand, a fact which eliminates the time usually necessitated on this operation in the ordinary sort of chain-block.

A special steel bail attends to the lifting of the load. The vertical arms of the bail are perforated near the bottom in which the bar thru the center of the roll is inserted. The arms themselves are bolted to the horizontal top member of the bail, in which three sets of bolt holes are provided, making the arms quickly adjustable for any width of cable drum.

The use of this new hoist, which is made by the Herbert Morris Crane & Hoist Co., Ltd., of Toronto, enables one man to attend to all loading and unloading operations at the plant. Prior to the installation six or seven men were required for exactly the same work.

A Contractor's Street Blockader

C. C. Fouts Co., Middletown, O., have devised a metal blockade for contractors' use on street contracts which is quite convenient and complete. It consists of two or more tripod stands of gas pipe which carry frames made of small channel bars braced 8 inches apart with rods. These frames are 10 ft. long and are hinged to flat bars attached to the upright part of the tripod stands. Two or more stands can be used according to the width of the space to be shut off from travel. By dropping the channel bars down over the supporting bars and dropping in the pin connections, the barricade is kept in a continuous straight line. By lifting the channel bars slightly they can be rotated on the pins and the barricade can be made to surround any space with its straight sides each 10 feet long.

In the center of each 10-foot frame is a plate with the word "Closed" on it in prominent letters, and above this is a bracket in which the red night lantern is set. On top of each of the tripod stands can be set a "stop" or "safety first" sign.

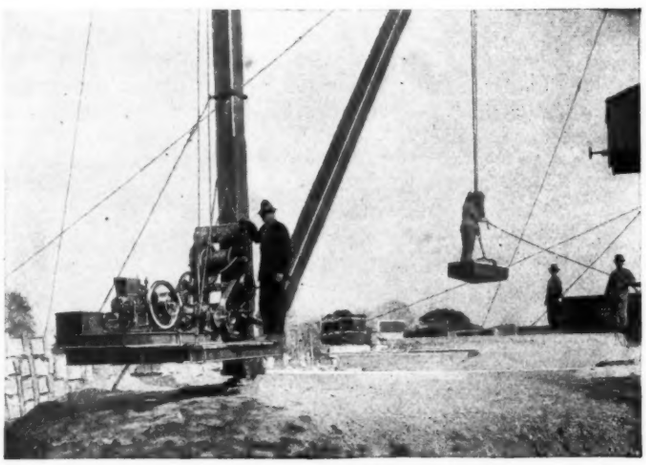
Domestic Special Hoisting Outfit

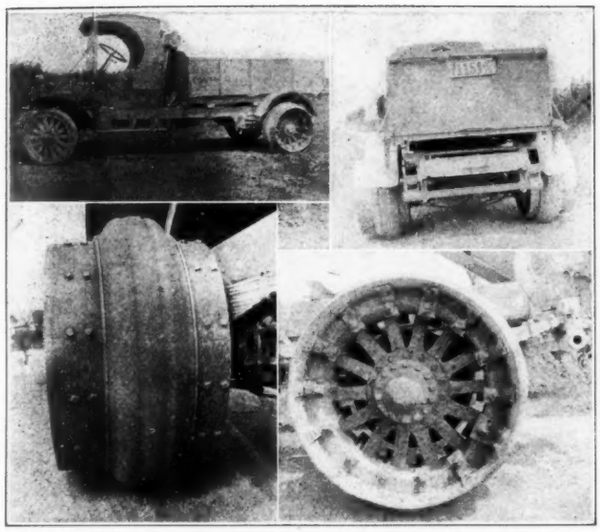
The Presbrey-Coykendall Co., of New York City, have for some time past been handling building stone and similarly heavy materials by the use of hand-operated double-purchase guy derricks combined with the Domestic special hoisting outfits, which are illustrated herewith.

The power equipment operates the single or double-purchase winch in connection with single or part lines just the same as by hand, the difference being that the power rig will operate continuously all day long without getting tired and at less expense than for labor to wind the winch. One man takes the place of the usual four or six winding by hand, and the load is always under full control.

The engine, the jack shaft with clutch, the two winch heads, and a platform that can be attached to the mast as a mounting for the hoist, form a self-contained unit. The sprockets, steel roller chain and several extra sprockets for power shaft to winch, so that the power unit can be coupled without difficulty to secure desired rope speed in connection with single or part lines, according to the load, also are accessory parts of the equipment.

The outfits, which are made by the Domestic Engine & Pump Co. of Shippensburg, Pa., are made with three sizes of engines: 3½, 5 and 7 h.p., all having variable speed control thru a speed-changing lever on the engine governor, and provision for further speed change by substitution of different sized sprockets. The engines are fitted with both dry battery and magneto ignition and hit-and-miss governor acting directly on the fuel consumption in exact ratio with power delivered to the load. The smallest outfit is intended for use with 12-in. or 14-in. derricks and the two larger with 14-in. or 16-in. masts.





New Extension Wheel Rim Invention

Mr. Albert E. Gray, who does a general contracting business in Goodland, Ind., has just secured a patent covering a new type of special extension rims for the rear wheels of his motor truck.

Mr. Gray's device overcomes the common trouble of having a heavily-loaded truck cut down into soft ground, sand or loose clay roads over which it may be traveling. The particularly noteworthy feature of the rims is that they accomplish the above and still do not interfere with operation under ordinary conditions. It is further understood that there is no particular objection to using these bands on a hard, solid or smooth road. Insofar as experiments yet have demonstrated, there is no detrimental effect on the truck, aside from the possibility that in running on the bands over a hard solid road, contact with the metal rims might occasion undue vibration.

Mr. Gray himself says: "The roads over which I have to travel are rutted so deeply that the very axle of my truck used to drag the ground and absolutely prohibit turning out whenever I wanted to. All that was at once nullified in effect after I had put the extension rims on my wheels. I then was able to make at least 50 per cent. better time with my truck. Whereas I formerly could get only 3 miles per gallon of gasoline on the rutted dirt roads, I now get 4½ miles per gallon. The truck runs faster and more smoothly. We now are making ten and eleven trips per day as contrasted with only seven trips on the same amount of gasoline and oil before I put on my rims.

"It is further interesting to know that there are twelve distinct ways of attaching the extension rims to truck wheels, and practically any kind of a wheel can be used."

The Service truck upon which Mr. Gray is using his invention carries 36 by 10-in. Firestone tires. The rim on the inside of the wheel is 31 by 4 in. wide, and on the outside 31 by 6 in. wide. The rims, which are made of 3/8 in. steel, are 98 in. in outside circumference and have 14 clips 1/2 in. thick, held secure by 14 bolts.

Load Test of Corrugated Iron Culvert

Prof. A. N. Talbot, who is in charge of the Materials Testing Laboratory of the University of Illinois, recently made an interesting test of the strength of the American ingot iron corrugated culverts in order to afford an impartial and authoritative statement for the Middletown, O., manufacturers.

He selected from the regular stock a culvert pipe 8 ft. in length and 36 inches in diameter, which was put in a hydraulic press and loaded as shown per the accompanying table report.

OFFICIAL REPORT OF TEST

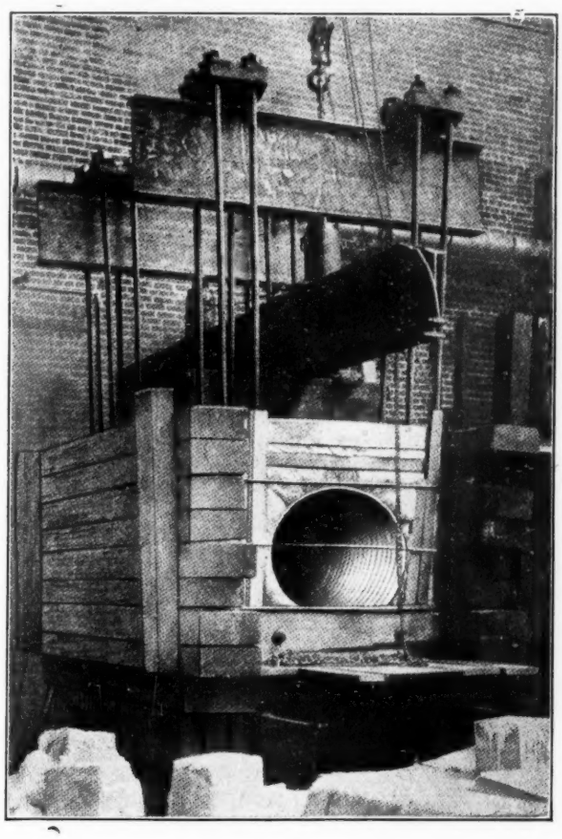
DISTRIBUTED LOAD TEST OF CORRUGATED CULVERT PIPE

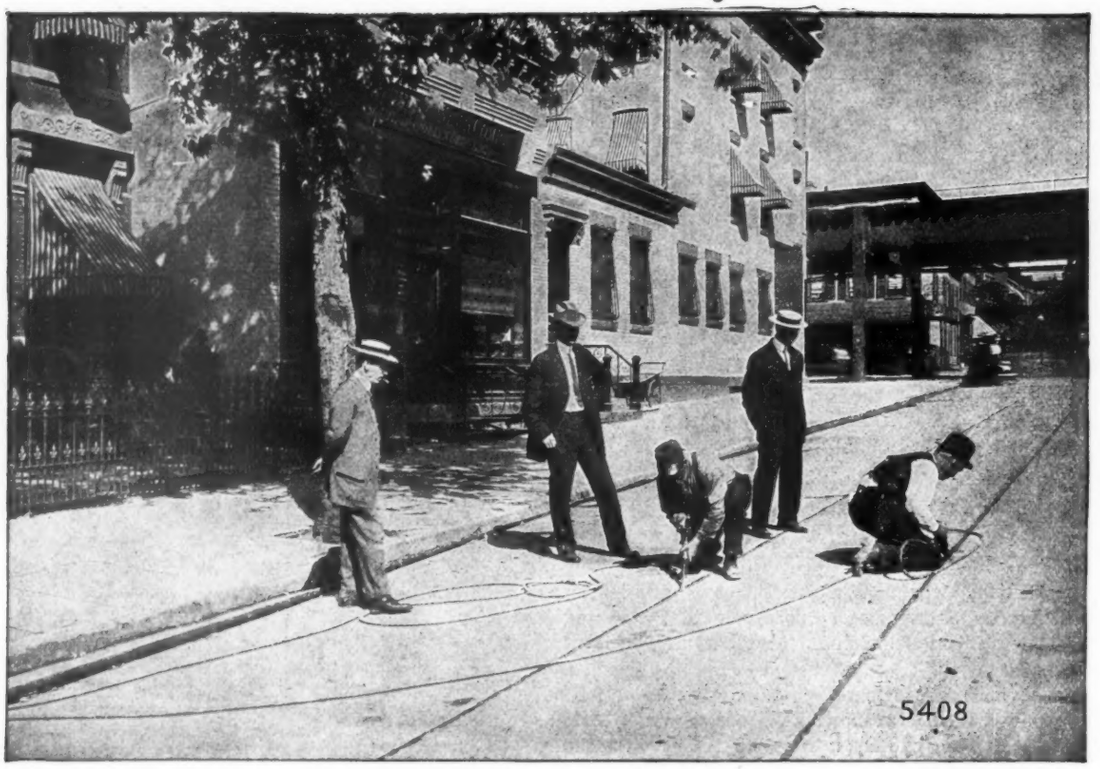
AMERICAN INGOT IRON 99.84% PURE.

Total Load on Pipe in Pounds	Load Per Lineal Foot in Pounds	CHANGE IN DIAMETER IN INCHES					
		LEFT END		RIGHT END		MIDDLE	
		Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
15000	1820	0.0	0.0	0.0	0.0	0.0	0.0
28000	3400	0.01	0.01	0.0	0.02	0.0	0.01
40000	4850	0.07	0.09	0.10	0.12	0.13	0.13
48000	5830	.22	.22	.24	.28	.32	.35
56000	6780	.31	.32	.40	.42	.47	.49
64000	7760	.37	.39	.48	.49	.57	.60
72000	8730	.45	.50	.61	.64	.72	.77
80000	9700	.54	.60	.72	.75	.83	.90
88000	10650	.69	.83	.83	.90	.98	1.05
96000	11600	.87	.91	1.03	1.10	1.32	1.30
104000	12600	.96	1.03	1.11	1.20	1.43	1.45
112000	13560	1.10	1.19	1.30	1.39	1.56	1.64
120000	14550	1.27	1.40	1.42	1.48	1.72	1.83
128000	15500	1.45	1.59	1.63	1.72	1.95	1.05
136000	16500	1.75	1.89	1.73	1.92	2.20	2.28
144000	17500	1.87	2.04	1.93	2.12	2.37	2.52
152000	18400	2.02	2.20	2.03	2.25	2.50	2.58
160000	19400	2.2	2.4	2.2	2.4	....	....
168000	20400	2.5	2.9	2.6	2.9	....	....
176000	21300	2.9	3.1	2.7	3.2	....	....
184000	22300	3.1	3.5	2.9	3.4	3.8	4.0
184000	22300	3.4	3.9	3.1	3.7	....	4.3
*15000	1820	2.4	3 2	2.6	3.0	....	....

* { Test Discontinued / Load Released

It will be noted that total load carried amounted to 184,000 lbs., or 92 tons, and that the total load per linear foot was 22,300 lbs., or over 11 tons. Despite this extraordinarily heavy fill Prof. Talbot states that the pipe still was in good condition at the conclusion of the test and no fracture was found in the metal.





"CROWN" PICKS BEING USED TO TEAR UP ASPHALT AT 12TH STREET, BROOKLYN, N. Y.

Crown Pick for Asphalt Cutting

We illustrate herewith Crown picks, such as recently were used to tear up asphalt on Twelfth street, Brooklyn, N. Y.

The Crown pick, type 56-H, is a pneumatic hammer especially adapted to tearing up asphalt pavements and loosening and wedging out bricks and stones when demolishing old structures. The valve is of a special spool type. The cylinder is made of special steel and the handle is drop forged.

The handle, which is of the closed type, is provided with an inside throttle trigger. This is really a safety device, as it removes the possibility of kicking the throttle open while the machine is lying on the ground with consequent chance of accident. In addition to the inside trigger a simple spring tool retainer is provided, which makes it impossible to shoot the pick out accidentally.

The use of Crown pneumatic picks for cutting asphalt when digging up streets for drain repairing, laying gas or water mains, repairing street car tracks, etc., results in a large saving. It is at its best when working in bitulithic topping and the different grades of asphalt.

The style of tools used and the manner in which they should be applied vary with different conditions according to the Ingersoll-Rand Co. of New York City.

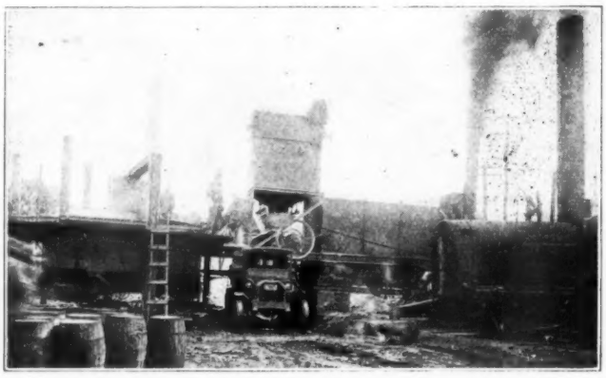
Asphalt Paving with a Road Asphalt Plant

The portable asphalt plant is each day more thoroly demonstrating its value in the asphalt paving field. One of the latest demonstrations is that made at Joliet, Ill., by the R. F. Conway Co., of Chicago, of the capabilities of an 1800-yard road asphalt plant, built by the F. D. Cummer & Son Company of Cleveland, O.

This plant is designed to be transported in several units so as to reduce the weight on the wheels and to make it easy to set the various parts in the most convenient fashion on the ground where it is to be operated.

The accompanying photographs show the two sides of the plant as set up early in the present season, alongside the Rock Island Railroad, a side track of which is seen with tank cars on it in front of the boiler and dryer.

In the view showing the loading of the motor truck with asphalt mixture, the boiler will be seen on the right. This

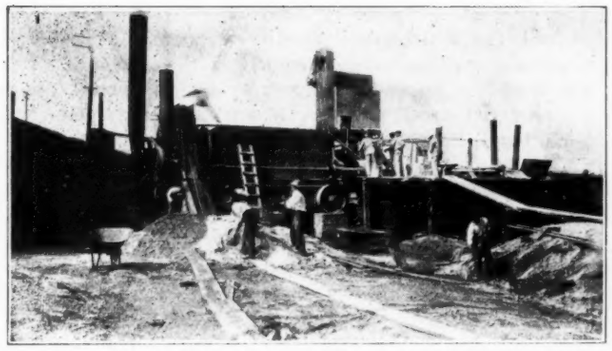


particular boiler and the engine behind it were the property of the company and set up to operate the plant and are not those furnished regularly with the Cummer plant.

Behind the boiler is the dryer for sand or broken stone, which is shown to better advantage in the other photograph, where the pile of aggregate is seen with men shoveling it onto the bucket elevator near the smoke stack, which delivers it to the revolving drum of the dryer.

W. T. Damewood, superintendent for the R. F. Conway Co., in charge of the plant, states that the dryer is of ample capacity for the plant and will handle regularly all the material which the men can supply to the elevator.

The dryer and its furnace are transported on wheels, set low, and the front wheels are on a frame hinged to the base frame of the dryer so that the whole machine can



be lifted to the height it stands in the picture. Part of this frame can be seen immediately under the smoke stack. The rear end of the dryer can be lifted likewise by attaching to the bottom of the fire-box the uprights to which the rear wheels are joined. But Mr. Damewood preferred to make the small concrete piers shown, on which to rest the rear wheels, without resetting them.

The housing of the hot elevator and of the bins for holding the hot aggregates is seen in the middle of each photograph.

Back of the mixer are three tanks for heating asphalt, two next the machine and one farther to the rear. These tanks are supplied with fire boxes and the hot liquid asphalt is pumped by a Kinney rotary pump from the tanks to the elevation of the mixer, where it is drawn off as needed into the weighing bucket. Bermudez asphalt is used on these contracts.

It will be seen from one picture that the reason for lifting the dryer is to make it possible for wagons to back under the mixer to receive their loads. A little more space is required for the Garford and Peerless trucks used for hauling, and so the earth was excavated about a foot to give the additional room.

Mr. Damewood reports that the plant has laid 20,000 square yards of pavement this season, the work having been done in about three weeks, and that 50,000 yards are yet to be laid, which he thinks he can do in 60 days. The capacity of the plant is shown by his statement that in 8 hours it has filled 34 truck loads of 14,000 pounds each, enough asphalt mixture to lay practically 2,300 square yards of pavement. He is very enthusiastic in his praise of the efficiency of the plant and his confidence seems to be well placed.

ROAD-OIL HEATING AND PUMPING OUTFIT.

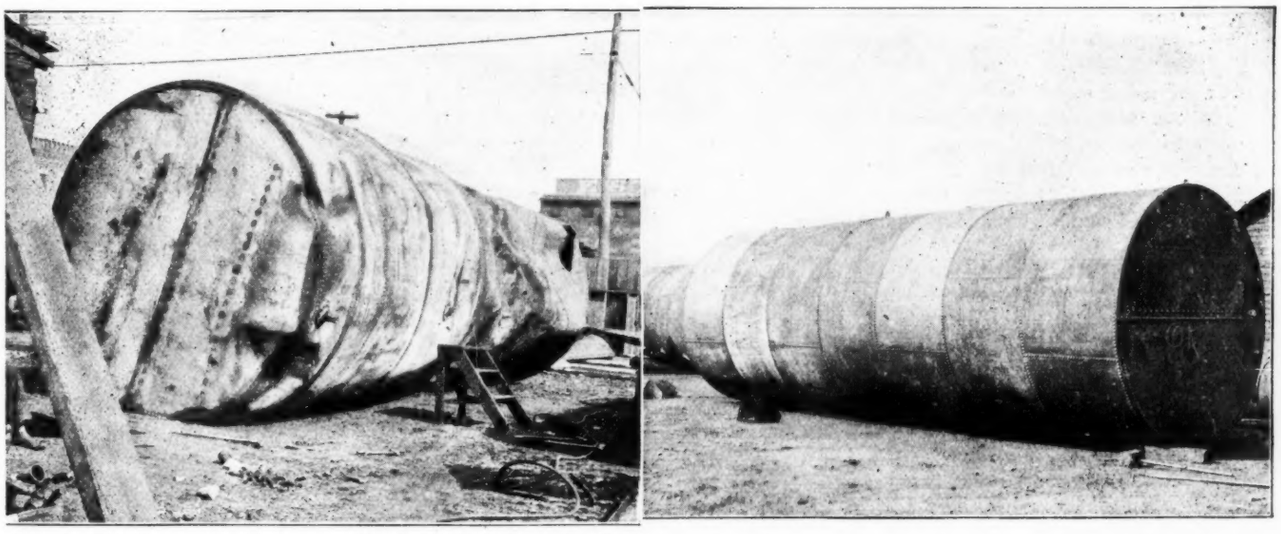
New Road-Oil Heating and Pumping Outfit

Experience caused Road Commissioner Emil Schmechel, of Thiensville—who is in charge of road work in Ozaukee County, Wis.—to devise plans for a new type of roal oil heating and pumping outfit, which really would economize on the time and trouble hitherto confronting his road crew. Mr. Schmechel's suggestions were submitted to and developed by the Gilson Mfg. Co., of Port Washington, Wis., and the result, illustrated herewith, has proven eminently satisfactory according to Road Commissioner Schmechel.

This outfit consists of a 30-h. p. steam boiler, a 4½-h. p. Gilson engine, together with a rotary pump. The steam boiler is used for heating the heavy road oil, which, after having become sufficiently fluid, is pumped into the tank wagons by means of the engine and rotary pump. It requires only 8½ minutes to fill a 600-gal. tank.

Air Drills Restore Tank

Another triumph was added recently to the many already credited to the mechanical engineering profession when the Johnson & Barry Steel Company, North Birmingham, Ala., accomplished the almost impossible task of restoring twelve large oil tanks, thirty feet long and ten feet in diameter, belonging to the Texas Oil Company, to their former career of usefulness. These tanks were a mass of burned and melted iron, full of great holes, bursted by various explosions during a recently fire. With a Chicago pneumatic boxer hammer the tanks were completely cut apart and straightened out. All rivets were removed by Boyer rivet busters

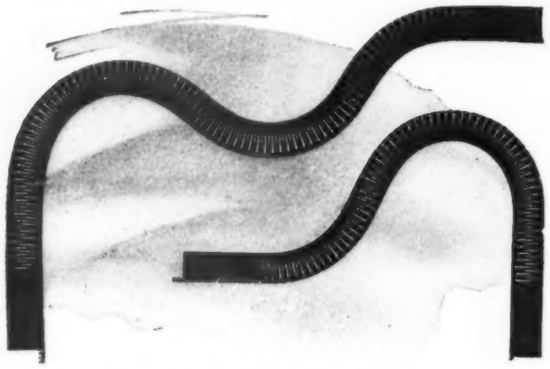


"BEFORE" AND "AFTER" PHOTOS OF TEXAS OIL COMPANY TANKS RESTORED TO USE WITH BOXER HAMMERS.

and the plates were riveted with Boyer riveting hammers. New iron was, of course, used to mend the spots where the iron was bursted out. Little Giant air drills were also used on this job and a Chicago pneumatic compressor supplied all the air used. The accompanying "before" and "after" photographs illustrate what a difficult task it was and how successfully it was completed.

A New Curve Rule

A new departure in flexible curve rules has been invented by the Keuffel & Esser Co., Hoboken, N. J. All of the flexibility of older rules is retained, together with an unusually light weight. The material is black xylonite, notched from



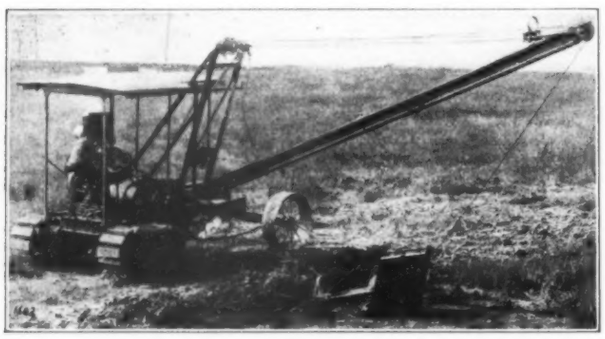
NEW FLEXIBLE CURVE RULE.

opposite edges, thus making the rule very flexible. On one edge is a ruling strip of black xylonite, and on the other a metal wire for retaining the rule in any curve into which it may be bent. Each extremity ends in a tangent.

Corduroy Trench Backfiller

A new back filler for sewer trenches has been put on the market by Pawling & Harnischfeger, Milwaukee, Wis., which is making a record for economy and rapidity of operation in filling pipe sewer trenches in Chicago. The accompanying photograph shows the machine ready for work and will make a brief description more clear. The machine is mounted with its rear wheels of the caterpillar tractor style, and it is mover forward or backward by its own power applied to these wheels. Steering is done by the engineer by means of the forward truck. The form of all the wheels is such that the machine can travel over very rough ground with ease, and so it can follow a trench readily thru the debris which is incident to sewer construction.

A jib boom is mounted on the frame of the machine, which is counterbalanced by the gasoline engine mounted on the other side of the machine, hidden by the driver in the photograph. This boom is a braced I-beam 22 feet long, which can be changed in length by adding an 8-foot extension.



The outer end of the boom is raised or lowered by the wire cable and the winch shown. The scraper is operated by the hoisting engine, which also moves the machine. It is of the drag-line excavator type and is of a special design, which does not require the services of a man to place it in position to be filled with dirt. By means of the two lines attached to it, which may be worked in opposition with each other, or either or both of them slackened up, the scraper can be dropped in position to take hold of the dirt at any point under the boom, and can be thrown to a distance of ten or fifteen feet beyond the end of the boom and catch the earth just as well. This makes the width of the space the machine can cover at least 40 feet. The scraper is 4 feet wide and built of steel plate, steel angles and oak planks, and is very ingeniously designed and mounted to make it self-acting.

The 12-h. p. 2-cylinder vertical hopper, cooled engine runs at 400 r. p. m. and is provided with a friction clutch of the internal-expansion-ring type, and is connected to the machinery by a high-speed roller chain. It has an efficient governor to regulate its speed, and the fuel is fed by pump from tank located in the base of the engine.

This backfiller has the corduroy traction, or caterpillar addition to the back-filler which the P. & H. company have had on the market for some time, and it weighs about 7 tons, as compared with 5 tons for the older machine.

The back-filler is a one-man machine, there being no necessity on straight work for but one man, and this one man, according to his own story on the job, can fill 100 feet of pipe-sewer trench in an hour or 900 feet in a 9-hour day. The cost of operating the machine is therefore very much less than that of filling the same amount of trench by hand. The standard price for backfilling on sub-contracts is about 8 cents per linear foot in Chicago, so that the 900 feet of backfilling, which is the machine's daily capacity, would cost $72 by hand. It is evident that with the machine the contractor can shade the standard price somewhat and still make a handsome profit on his investment.

The backfiller has been used successfully in cutting off the top of an old graded street, hardened by the travel down its center, making it easier for the trench machine to work, and it should be possible to use it for a number of similar purposes, thus making it a valuable piece of apparatus at all times for the contractor, and not alone for finishing up the job.

The writer has seen the machine operated successfully, tho, of course, more slowly, when the trench-filling material was piled in a row of trees. The engineer was able by throwing his scraper skillfully and running the machine forward and backward short distances to handle practically all of the dirt and scrape it into the trench and the side trenches for catch-basin and house connections. The ease with which the machine moved and the way in which the corduroy tractor followed the ground and bridged small breaks in the surface was remarkable, only less so than the certainty with which the bucket was dropped in the place for moving just the bit of dirt wanted.

Pawling & Harnischfeger will send any desired detail of information about the machine, which has now demonstrated its utility and its economy, and its ability to make good money for its owner and operator.

Enlargement of Gramm-Bernstein Company

The Gramm-Bernstein Company, of Lima, Ohio, makers of the well-known motor truck of that name, have done such an enormous business that in order to finance the concern properly a considerable increase in capitalization has been made, the method being to form the Gramm-Bernstein Motor Truck Company, with a capitalization of $3,000,000 common stock

and $1,000,000 preferred stock, to take over the business and operate it on the larger scale made necessary by the phenomenal development of the use of the truck.

M. Bernstein is president and treasurer of the new corporation and B. A. Gramm is vice president and general manager. Mr. Gramm is called the father of the motor truck industry, being one of the pioneers in their manufacture.

Mr. Gramm's inventions, including his transmission and transmission control, auxiliary drive off the transmission for driving hoists, pumps and the like, are among the important assets of the company.

The company's line includes trucks ranging in capacity from one to six tons, and they are successful in meeting any of the demands made by contractors or other truck buyers, as well as the foreign users of trucks for war purposes.

Fuel from Municipal Waste

By T. J. Lacy, Austin, Texas.

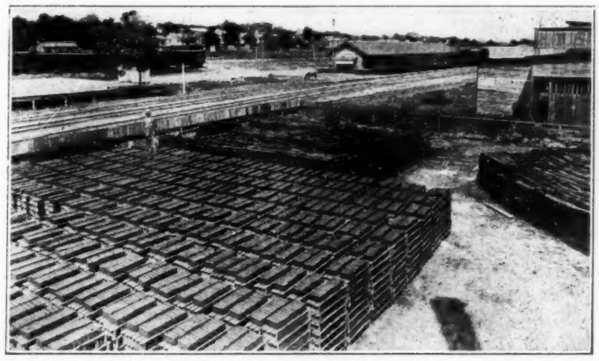
The factory of the Austin Oakoal Manufacturing Company is now complete and in operation after having burned down once and after many setbacks, due to the necessity of originating the machinery required for producing the new fuel bricks in a profitable manner. The factory, which is at East Fourth and Brushy streets, has now been in operation several weeks.

The company is composed of about forty leading Austin men, who believe that they see a great future for this process of converting city garbage and refuse into a high grade fuel, and they are now planning the erection of a second plant. They say the trash and garbage collected by the carts of the city sanitary department is sufficient to keep two plants going.

From the standpoint of the city the new enterprise is regarded as a most fortunate development, for already the city government has experienced the greatest difficulty in finding places in which to dispose of the waste without arousing the active resentment of the residents of the neighborhood. The erection of a garbage disposal plant at a cost of $75,000 or more was seen as a necessary step in the near future had the Oakoal plant proved unsuccessful. The city's contract with the Oakoal Company is that the company shall dispose of all of the city's refuse and garbage in a sanitary manner at a cost to the city equal to about half the cost of incineration.

The manufacture of the fuel is quite interesting, inasmuch as it is made up entirely of waste material handled by common labor. The waste, which the city had to burn formerly in the incinerator, and the garbage is taken by carts to the factory and dumped. It is then sorted and the non-combustible materials, such as iron, bottles, tin-cans, etc., are segregated and sold. That which is left is placed upon a large belt and carried to a grinder, which reduces it to even sizes. It is then conveyed by elevator to a storage bin at the top of the building. Coal slack, another waste product, is shipped

MUNICIPAL WASTE, GARBAGE AND TRASH, IN PLANT STORAGE BEFORE TREATMENT.



MUNICIPAL WASTE AFTER TREATMENT, DRYING IN THE PLANT YARD.

in car loads and passed thru another grinder and placed in a bin alongside the first one. The two products now come together in a mix machine or pulper, where steam, hot water and creosote or water gas tar are injected, reducing the mass to a pulp.

The water gas tar is another waste product which the gas works usually run into the river or sewer. It contains a powerful disinfectant and its presence makes the finished product impervious to moisture. The hot steam thoroly sterilizes the material.

The product is now conveyed to a brick molding press, which presses the material into the shape of building brick at the rate of forty each minute. Each brick weighs two pounds. The fuel is then placed on wooden pallets and set aside to mature and dry. In a few days it is ready for market.

The plant gives employment to twenty men, including draymen, and is capable of making fifteen to twenty tons daily. The price for 1,000 bricks or one ton is $6.50 to the customer. The chemical analysis of the University of Texas shows over 12,000 B. t. u. per pound, as much as the best Oklahoma bituminous coal. Oak wood has 8,000 heat units and consequently Oakoal is one and one-half times as strong as oak wood in heat.

One of the best business men, a merchant in the city, has stated that he burned one ton of Oakoal in his cooking stove and it gave better results and lasted longer than two cords of oak wood. It is very good in heaters, fire-place grates, base burners, small boilers and ranges. It is burned successfully in bakery ovens. This fuel will be most appreciated by poor people in the cold season, when they can buy it at one cent a brick or less in quantities.

This new method of garbage disposal is creating considerable interest among municipalities, as the disposal of municipal waste in a sanitary manner has been both a troublesome and an expensive problem. The Mutual Film Company of New York have secured pictures of the plant in operation, which will be shown thruout the country.

The perfection of the system is due to several years' experiments of E. L. Culver, formerly of Austin, Tex., now located in the Conway Building at Chicago. Mr. Culver states that as a result of this plant several cities in the United States and Canada have adopted this system, and a plant of the most modern and up-to-date construction is being erected at St. Joseph, Missouri.

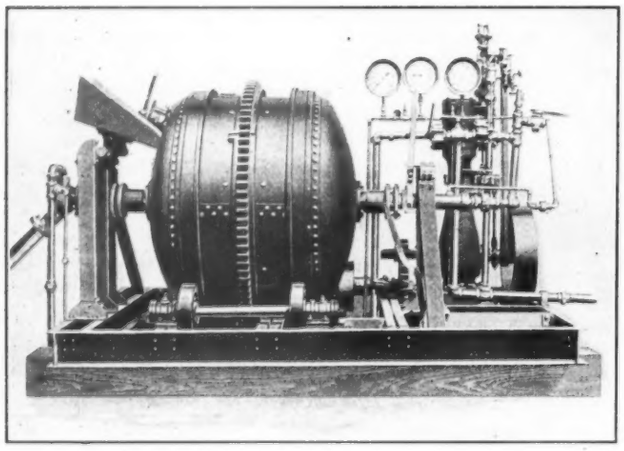
Radical Departure in Mixers and Conveyors

The hopper-type mixer and conveyor has proven to be a generally economical means of placing concrete in tunnels and certain types of mass concrete work, but a new and novel device recently has been perfected.

This machine combines mechanical mixing with pneumatic conveying and placing and is suitable for all types of concrete work of both large and small yardage, in light walls or in mass, re-inforced or unre-inforced concrete.

The device comprises a cylindrical drum set on a horizontal axis driven by an independent motor or engine. Within the drum are mechanical mixing apparatus and special contrivances for delivering the mixed concrete to the outlet thru which it is ejected by pneumatic pressure without any suspension of the machine's rotation. Following the ejection of one batch of mixed concrete the machine is stopped, recharged thru the hopper and the process is continued with unusual rapidity.

A pipe from 2 to 8 inches in diameter may be connected with the hollow trunnion outlet, and thru it this concrete is discharged in a continuous stream with a velocity of approximately 50 ft. per second, despite so low an air pressure as from 15 to 20-lb. per square inch. Most of the ordinary types of pneumatic distributing machinery have been characterized by air pressure fluctuations of from 5 to 40 lbs., but in this new device the pressure is maintained steadily and uniformly. The consistent output of mixed concrete nearly doubles the capacity of the machine and reduces the necessary amount of compressed air by half for every cubic yard of concrete placed. One of the prominent features of the machine is that concrete made with 1-inch stone may be



discharged thru a 2-inch pipe; 1½-inch stone concrete thru a 3-inch pipe; 2-inch stone concrete thru a 4-inch pipe, and, furthermore, concrete made with the run of ordinary crusher stone thru a 6-inch pipe.

Machines of this type fitted with 2 or 3-inch discharge pipes distribute the concrete to a total horizontal distance of nearly 500 ft. and a vertical height of 90 ft. The larger sizes, with 4 to 8-inch discharge pipes, can place it horizontally 300 ft. distant and 100 ft. high.

One man, beside those supplying material, is sufficient to operate the machines, which, up to even the 4-inch discharge pipes, have a capacity of between 20 and 50 yds. of concrete mixed and placed in 8 hrs. All labor from the mixer to and into the forms is eliminated, except for the two men who handle the delivery hose to place concrete directly into the forms. This two-man crew is sufficient for placing a small or large yardage.

Operating under favorable conditions the large new machine has an 8-hr. capacity of about 500 yds. of concrete. A 2-bag machine, with a 3-inch outlet, weighs in all about 8,000 lbs. and is run by an 8-h. p. engine or motor. It is said that a speed of about 16 r. p. m. produces the best results and any degree of consistency can be adequately handled with it.

The inventor and developer of the machines, James H. Graham, is placing it on the market thru the Pneumatic Placing Co., Inc., of New York City.

Trade Notes

Two of the three new motor pumps ordered by the Hartford, Conn., fire department have been delivered. They are American-LaFrance, of 750 gallons a minute capacity, with a chemical tank and hose and capacity for 1,000 feet of regulation fire hose. One of the machines replaces four horses and the other five heretofore in use. The third machine will be delivered shortly.

The Clydesdale Brick and Clay Company, of Pittsburgh, Pa., with a new plant at Elwood, Pa., has become a licensee of the Dunn Wire-Cut Lug Brick Company, of Conneaut, O. H. J. Orth is president of the Clydesdale company and W. W. Cunningham vice president and general manager. The Clydesdale plant at Elwood will have a daily capacity of 100,000 paving brick. It is the intention of the company to double the plant's capacity in the near future.

The Sewell Cushion Wheel Company, of Detroit, have opened a branch in Pittsburgh, at 711 First National Bank building, under the management of Mr. E. G. Burley. This makes the thirteenth branch which has been opened by this company, the others being located in New York, Chicago, Philadelphia, Buffalo, St. Louis, Boston, Cleveland, Minneapolis, Rochester, Baltimore, Seattle and Los Angeles.

For more than five years patent infringement suits have been fought in the federal courts between the Sanitary Street Flushing Machine Company, owners of the Ottofy patents, and various infringers. The Ottofy patent, No. 795,059, covers "any flushing machine made or that can be changed or adjusted to deliver a flat stream of water under pressure, forward and latterly, at an angle of 20 degrees or less." This claim having been sustained in the courts, Studebakers concluded to acquire the patent. The Studebaker Municipal Utilities Company was organized for that purpose, and is now the owner of the Ottofy and various other patents covering the modern art of street flushing. Flushers manufactured under these patents will in the future be marketed through the vehicle division of the Studebaker organization.

A. N. Moore, vice president and treasurer of the Oregon Portland Cement Company, of Oswego, Ore., on August 29 filed with the United States Court in Portland a suit charging fourteen cement companies of the United States and Canada with illegally combining in violation of the Sherman and Clayton anti-trust acts, alleging that they sought to restrict the production in his plant to one-sixth its capacity and to dictate the exact territory in which he may do business, and that the prices maintained cause the coast states to pay more than a million dollars annually in excess of what they should pay.

Trade Publications

Studebaker Corporation, South Bend, Ind., in their serial No. A 892, entitled "Analyze Your Bid," show their dump wagons and the details that are of special interest.

Dust-proof refuse collection is the subject of a booklet of H. Kastor, Hotel Netherlands, New York, descriptive of the Ochsner sanitary system of refuse and garbage collection.

The Barber Asphalt Paving Company, Philadelphia, Pa., puts it up to the reader of a recent circular to make the decision of the proper asphalt, and explains the reasons for the claims of superiority for natural asphalts.